

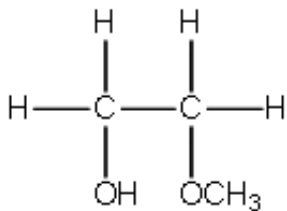
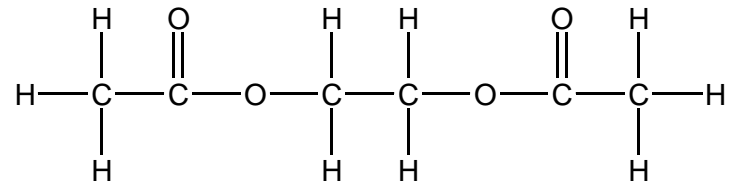
Question		Answer	Mark	Guidance
1	(a)	$ \begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \quad \\ \text{H}_3\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{Br} \quad \text{Br} \quad \checkmark \end{array} $	1	<p>ALLOW correct structural OR displayed OR skeletal formula OR mixture of the above</p> <p>DO NOT ALLOW molecular formula</p> <p>ALLOW dichloro or diiodo compound instead of the dibromo compound as the only alternatives.</p>
	(b)	Reagent A : correct halogen ✓ e.g. Br ₂ / bromine	1	<p>ALLOW Cl₂ if dichloro compound drawn</p> <p>ALLOW I₂ if diiodo compound drawn</p> <p>IGNORE state symbols</p> <p>Answer must match box from (a) to score</p>
	(c) (i)	Steam AND acid catalyst ✓	1	<p>ALLOW H⁺ / named acid / H₂SO₄ / H₃PO₄</p> <p>ALLOW H₂O(g)</p> <p>ALLOW water only if a temperature of 100 °C or above is quoted.</p> <p>IGNORE any temperature given with steam</p> <p>IGNORE pressure</p>
	(ii)	(compounds or molecules) having the same molecular formula but different structural formulae ✓	1	<p>ALLOW different structure OR different displayed formula OR different skeletal formula for structure</p> <p>Same formula is not sufficient</p> <p>Different arrangement of atoms is not sufficient</p>
	(iii)	$ \begin{array}{c} \text{CH}_3 \text{CH}_3 \\ \quad \\ \text{H}_3\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{OH} \quad \text{H} \quad \checkmark \end{array} \quad \begin{array}{c} \text{CH}_3 \text{CH}_3 \\ \quad \\ \text{H}_3\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{OH} \quad \checkmark \end{array} $	2	<p>ALLOW correct structural OR displayed OR skeletal formula OR mixture of the above</p> <p>ALLOW any vertical bond to OH</p> <p>DO NOT ALLOW OH⁻</p>
	(iv)	<p>Does not contain OH group(s)</p> <p>OR does not contain hydroxyl group(s)</p> <p>OR is not an alcohol ✓</p> <p>Does not form hydrogen bonds with water ✓</p>	2	<p>ALLOW ORA throughout</p> <p>DO NOT ALLOW OH⁻ (ions) / hydroxide (ions)</p> <p>'Does not form hydrogen bonds' is not sufficient</p>

Question	Answer	Mark	Guidance
(d)	<p>Reagents: Acid/H⁺ and (potassium or sodium) dichromate/Cr₂O₇²⁻ seen once ✓</p> <p>Observations: Orange to Green OR Orange to Blue ✓</p> <p>Distillation / Distil produces aldehyde/CH₃CH₂CHO: ✓</p> <p>CH₃CH₂CH₂OH + [O] → CH₃CH₂CHO + H₂O ✓</p> <p>Reflux (of propan-1-ol) produces carboxylic acid/CH₃CH₂COOH ✓</p> <p>CH₃CH₂CH₂OH + 2[O] → CH₃CH₂COOH + H₂O ✓</p>	6	<p>ANNOTATE ANSWER WITH TICKS AND CROSSES ETC</p> <p>ALLOW H₂SO₄ and K₂Cr₂O₇</p> <p>ALLOW correct displayed formula OR correct structural formula OR skeletal formula OR a mixture of the above</p> <p>DO NOT ALLOW molecular formulae</p> <p>ALLOW C₃H₇OH for propan-1-ol in equations</p> <p>DO NOT ALLOW CH₃CH₂COH for aldehyde</p> <p>IGNORE further oxidation of aldehyde</p> <p>ALLOW CH₃CH₂CO₂H for carboxylic acid</p>
	Total	14	

Question			Answer	Marks	Guidance
2	(a)	(i)	E and H ✓	1	ALLOW pentan-2-ol and 2-methylbutan-2-ol
		(ii)	H ✓	1	ALLOW 2-methylbutan-2-ol
		(iii)	F ✓	1	ALLOW propan-1-ol
	(b)	(i)	C ₅ H ₁₀ O ✓	1	ALLOW any order of atoms DO NOT ALLOW C ₅ H ₉ OH
		(ii)	2-methylpentan-3-ol ✓	1	ALLOW 2-methylpentane-3-ol ALLOW absence of hyphens or use of commas ALLOW space between methyl and pentan DO NOT ALLOW 2-methylpent-3-ol OR 2-methylpentan-3-ol OR 2-metpentan-3-ol, 4-methylpentan-3-ol etc
	(c)		(series of compound) with same functional group ✓ and each successive member differing by CH ₂ ✓	2	IGNORE with same or similar chemical properties OR same or similar chemical reactions IGNORE references to physical properties or named physical properties vary with an observable trend. IGNORE have similar or the same physical properties IGNORE has same general formula ALLOW each subsequent member varying by CH ₂ DO NOT ALLOW have the same empirical formula OR have the same molecular formula

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2 (d)	<p>heat with acidified $K_2Cr_2O_7(aq)$</p> <p>heat with CH_3COOH and an acid catalyst</p> <p>heat with an acid catalyst</p>	4	<p>ALLOW correct structural OR displayed OR skeletal formula OR mixture of the above (as long as unambiguous)</p> <p>IGNORE inorganic products if written in, eg H_2O for the elimination reactions</p> <p>IGNORE names of compounds</p> <p>ALLOW in either order</p>
Total		11	

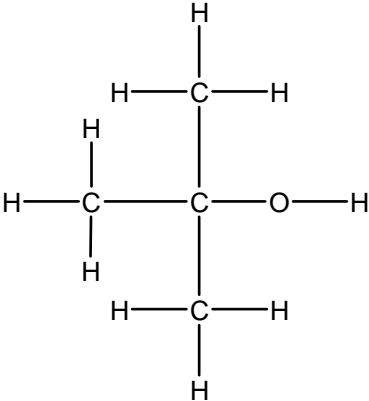
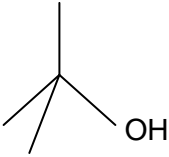
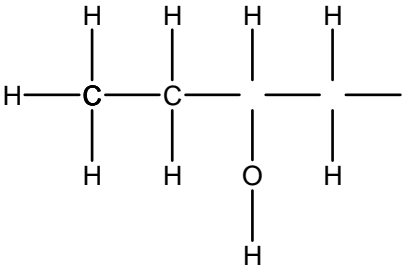
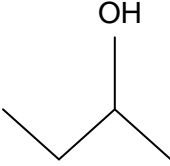
Question			Answer	Marks	Guidance
3	(a)	(i)	$2\text{C}_2\text{H}_4 + \text{O}_2 \rightarrow 2\text{C}_2\text{H}_4\text{O}$ ✓	1	ALLOW molecular formulae OR correct structural OR displayed OR skeletal formula OR mixture of the above (as long as unambiguous) ALLOW correct multiples, including fractions, of this equation IGNORE state symbols DO NOT ALLOW [O]
		(ii)	$\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$ ✓	1	ALLOW molecular formulae OR correct structural OR displayed OR skeletal formula OR mixture of the above (as long as unambiguous) ALLOW correct multiples of this equation IGNORE state symbols DO NOT ALLOW [O]
	(b)	(i)	✓ 	1	Only one carbon atom needs to have the correct partial charge DO NOT ALLOW partial charges on hydrogen atoms
		(ii)	Movement of an electron pair ✓	1	ALLOW movement of a lone pair OR movement of a bond ALLOW movement of two electrons
		(iii)	Heterolytic ✓ Both electrons (in the bond) go to the same atom OR (bond breaks) to make a cation and (a lone pair on the oxygen atom) OR bond pair becomes a lone pair on oxygen ✓	2	MARK INDEPENDENTLY ALLOW one atom gets none of the bonded electrons DO NOT ALLOW both electrons go to a molecule DO NOT ALLOW makes a positive and a negative ion because in this example this is not true
		(iv)	It donates a pair of electrons ✓	1	ALLOW donates a lone pair DO NOT ALLOW it donates electrons
		(v)	idea that H^+ ion is used in step 1 AND made in step 4 ✓	1	ALLOW H^+ ion is used at the start AND made at the end IGNORE overall H^+ is not used up in the mechanism

Question		Answer	Marks	Guidance
(b)	(vi)	 ✓	1	ALLOW correct structural OR displayed OR skeletal formula OR mixture of the above (as long as unambiguous) eg CH ₂ OHCH ₂ OCH ₃ ALLOW vertical 'bond' to any part of the OH or OCH ₃ group DO NOT ALLOW formula with horizontal -HO OR OH- DO NOT ALLOW formula with horizontal -CH ₃ O OR OCH ₃ -
(c)		Ethane-1,2-diol has more OH groups (than ethanol) ✓ Stronger hydrogen bonding (between ethane-1,2-diol molecules) ✓	2	ALLOW has more hydroxyl groups OR has more hydroxy groups OR has more alcohol groups Ethane-1,2-diol has two OH groups is NOT sufficient but ALLOW ethane-1,2-diol has two OH groups and ethanol has one DO NOT ALLOW it has hydroxide (ions) ALLOW more hydrogen bonds (between ethane-1,2-diol molecules) IGNORE hydrogen bonds with water
(d)		One ester linkage drawn despite the rest of the structure ✓ Correct structure for example CH ₃ COOCH ₂ CH ₂ OOCCH ₃ OR  ✓	2	ALLOW correct structural OR displayed OR skeletal formula OR mixture of the above (as long as unambiguous) ALLOW ester shown as all the atoms OR as -COOC- OR -CH ₂ OOC- OR -CH ₂ OCOC- IGNORE molecular formula

Question	er	Marks	Guidance
(e)	<p><i>Any two from:</i></p> $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ =\text{C} - \text{C} = \text{O} \end{array} \quad \begin{array}{c} \text{O} \quad \text{O} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{O} - \text{H} \end{array}$ $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ -\text{O} - \text{C} - \text{C} = \text{O} \\ \\ \text{H} \end{array} \quad \begin{array}{c} \text{H} \quad \text{O} \\ \quad \\ -\text{O} - \text{C} - \text{C} - \text{O} - \text{H} \\ \\ \text{H} \end{array}$ $\text{H} - \text{O} - \begin{array}{c} \text{O} \\ \\ \text{C} \end{array} - \begin{array}{c} \text{O} \\ \\ \text{C} \end{array} - \text{O} - \text{H}$ <p>✓✓</p>	2	<p>Mark incorrect answers first</p> <ul style="list-style-type: none"> • If one incorrect answer maximum of 1 mark • If two incorrect answers award 0 marks <p>ALLOW OH instead of $-\text{O}-\text{H}$</p> <p>ALLOW vertical 'bond' to any part of the OH DO NOT ALLOW formula with horizontal $-\text{HO}$ OR $\text{OH}-$ but ALLOW ECF if both displayed formulae are drawn this way</p> <p>ALLOW one mark if two correct structural OR skeletal formula OR mixture of the above (as long as unambiguous) are drawn</p>
	Total	15	

Question			Answer	Mark	Guidance
4	(a)	(i)	$C_nH_{2n+1}OH$ ✓	1	ALLOW $C_nH_{2n+2}O$
		(ii)	$C_{13}H_{28}O$ ✓	1	ALLOW $C_{13}H_{27}OH$
	(b)		group of atoms OR part of a molecule ✓ that give a compound its (characteristic set of) reactions ✓	2	ALLOW part of an alcohol IGNORE part of a compound ALLOW that determines its chemical properties OR that gives the compound its reaction ALLOW that determines its homologous series
	(c)	(i)	Alkanes have van der Waals' intermolecular forces ✓ Alcohols have hydrogen bonds (and van der Waals' forces) ✓ Hydrogen bonds are stronger (than van der Waals' forces) OR ORA ✓	3	ANNOTATE ANSWER WITH TICKS AND CROSSES ALLOW reference to specific compounds e.g. comparing methane and methanol vdW force is not sufficient here Third marking point is dependent on the correct intermolecular forces being described BUT ALLOW hydrogen bonds are stronger than intermolecular forces in alkanes
		(ii)	Methylpropan-1-ol has weaker van der Waals' forces (than butan-1-ol) OR ORA ✓ Methylpropan-1-ol has less surface contact (than butan-1-ol) OR ORA OR Methylpropan-1-ol has more branching (than butan-1-ol) OR ORA ✓	2	ALLOW methylpropan-1-ol has fewer van der Waals' forces (than butan-1-ol) IGNORE reference to more surface area / molecules are closer ALLOW methylpropan-1-ol is branched and butan-1-ol is not IGNORE 'methylpropan-1-ol is branched' with no comparison

Question		Answer	Mark	Guidance
(d)	(i)	$\text{CH}_3\text{OH} + 1\frac{1}{2}\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O} \checkmark$ $\text{CH}_3\text{OH} + \text{O}_2 \rightarrow \text{CO} + 2\text{H}_2\text{O} \checkmark$	2	<p>ALLOW CH_4O</p> <p>for incomplete combustion ALLOW $\text{CH}_3\text{OH} + \frac{1}{2}\text{O}_2 \rightarrow \text{C} + 2\text{H}_2\text{O}$ ALLOW $2\text{CH}_3\text{OH} + 1\frac{1}{2}\text{O}_2 \rightarrow \text{C} + \text{CO} + 4\text{H}_2\text{O}$</p> <p>ALLOW correct multiples of these equations</p> <p>IGNORE state symbols</p>
	(ii)	insufficient supply of oxygen OR limited amount of air OR poorly ventilated \checkmark	1	
	(iii)	Feedstock (in manufacture of organic compounds) OR manufacture of biodiesel OR manufacture of esters. \checkmark	1	<p>ALLOW manufacture of a named organic compound that can be made from methanol</p> <p>ALLOW antifreeze, screenwash</p>
(e)		$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} \checkmark$ BUT $\text{C}_4\text{H}_9\text{OH} + 2[\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} + \text{H}_2\text{O} \checkmark\checkmark$	2	<p>One mark is for the correct structure of the product One mark is for the equation</p> <p>ALLOW $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ DO NOT ALLOW $\text{C}_4\text{H}_8\text{O}_2$, $\text{C}_3\text{H}_7\text{COOH}$, $\text{C}_4\text{H}_7\text{OOH}$ for the structure mark but ALLOW for the equation mark</p> <p>Give credit for the correct structure in the equation e.g. $\text{C}_4\text{H}_9\text{OH} + 2[\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} + \text{H}_2\text{O}$ scores two marks but $\text{C}_4\text{H}_9\text{OH} + [\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} + \text{H}_2$ scores one mark $\text{C}_4\text{H}_{10}\text{O} + 2[\text{O}] \rightarrow \text{C}_4\text{H}_8\text{O}_2 + \text{H}_2\text{O}$ scores one mark</p> <p>ALLOW one mark for: $\text{C}_4\text{H}_9\text{OH} + [\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CHO} + \text{H}_2\text{O}$</p>

Question		Answer	Mark	Guidance
(f)	(i)	methylpropan-2-ol OR 2-methylpropan-2-ol ✓ 	2	DO NOT ALLOW methylprop-2-ol ALLOW (CH ₃) ₃ COH ALLOW vertical 'bond' to any part of the OH group DO NOT ALLOW horizontal -HO in the formula ALLOW 
	(ii)		1	ALLOW CH ₃ CHOHCH ₂ CH ₃ ALLOW  ALLOW vertical 'bond' to any part of the OH group DO NOT ALLOW horizontal -HO in the formula IGNORE an incorrect name
Total			18	