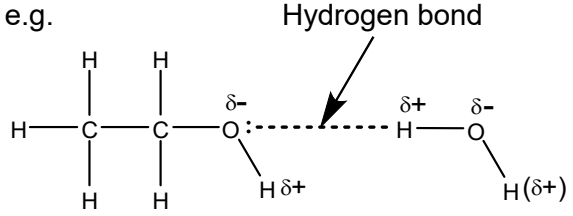
Mark Scheme

SECTION A

Question	Key	Marks	Guidance
1	B	**1**	

Mark Scheme

Question			Answer	Marks	Guidance
2	(a)		$C_5H_{10}O + 7O_2 \longrightarrow 5CO_2 + 5H_2O$ ✓	1	**ALLOW** multiples e.g. $2C_5H_{10}O + 14O_2 \longrightarrow 10CO_2 + 10H_2O$ **ALLOW** any equation involving an unsaturated alcohol with correct balancing **e.g.** $C_5H_8O + 6.5O_2 \longrightarrow 5CO_2 + 4H_2O$ $C_5H_6O + 6O_2 \longrightarrow 5CO_2 + 3H_2O$ $C_5H_4O + 5.5O_2 \longrightarrow 5CO_2 + 2H_2O$ $C_5H_2O + 5O_2 \longrightarrow 5CO_2 + H_2O$ **IGNORE** state symbols
	(b)	(i)	Diagram showing a water molecule and an ethanol molecule with at least one $H^{\delta+}$ and one $O^{\delta-}$ on **BOTH** molecules ✓ Hydrogen bond between one lone pair on O atom in one of the molecules and the H atom of another. **AND** Hydrogen bonding stated or labelled on diagram ✓ e.g. 	2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **DO NOT ALLOW** δ+ on H atoms of alkyl group **DO NOT ALLOW** any marks for a diagram containing O_2H If more than one hydrogen bond is shown they must **all** be correct to award the mark.

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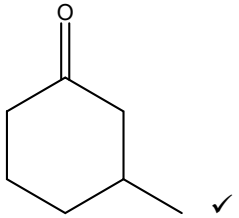
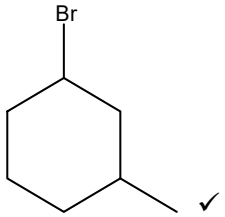
Question			Answer	Marks	Guidance
		(ii)	Hexane-1,6-diol has more OH groups (than hexan-1-ol) **AND** (hexane-1,6-diol) forms more hydrogen bonds **with water** ✓	1	Statements **MUST** be comparative e.g. hexane-1,6-diol has two –OH groups and hexan-1-ol has one -OH group **ALLOW** hydroxyl or hydroxy **DO NOT ALLOW** hydrox**ide**/OH^- **ALLOW ORA**
	(c)	(i)	**Starting material from reduction reaction**  ✓ **Reagent for reduction** $NaBH_4$ ✓ **Product from reaction with $NaBr/H_2SO_4$**  ✓ **Structural isomers**	5	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous Watch for missing methyl groups **IGNORE** H^+ / acid or H_2O or ethanol **ALLOW** sodium borohydride **OR** sodium tetrahydridoborate **ALLOW** $LiAlH_4$

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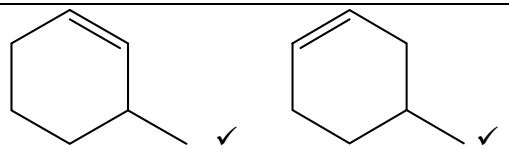
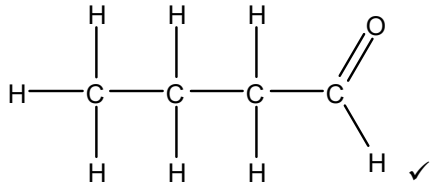
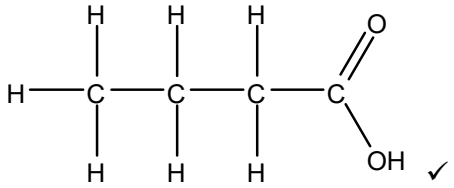
Question			Answer	Marks	Guidance
			 ✓ ✓		**ALLOW** in either order
		(ii)	3-methylcyclohexanol ✓	**1**	**ALLOW** 3-methylcyclohexan-1-ol **ALLOW** 1-methylcyclohexan-3-ol **IGNORE** lack of hyphens, or addition of commas
	(d)		**Structures of organic products**  ✓  ✓ **Equations** $CH_3CH_2CH_2CH_2OH + [O] \longrightarrow CH_3CH_2CH_2CHO + H_2O$ ✓ $CH_3CH_2CH_2CH_2OH + 2[O] \longrightarrow CH_3CH_2CH_2COOH + H_2O$ ✓ **Reaction conditions**	**5**	**ANNOTATE WITH TICKS AND CROSSES** Use of any primary alcohol containing 3, 5 or more carbons can be awarded up to 4 marks. **ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **IGNORE** names **DO NOT ALLOW** $CH_3CH_2CH_2COH$ for the structure of the aldehyde. **ALLOW** $CH_3CH_2CH_2CO_2H$ for the structure of the carboxylic acid. **ALLOW** marks for structures from equations as long as unambiguous. **ALLOW** molecular formulae in equations e.g. $C_4H_{10}O + [O] \longrightarrow C_4H_8O + H_2O$ $C_4H_{10}O + 2[O] \longrightarrow C_4H_8O_2 + H_2O$ $C_4H_9OH + [O] \longrightarrow C_3H_7CHO + H_2O$ $C_4H_9OH + 2[O] \longrightarrow C_3H_7CO_2H + H_2O$ **IGNORE** incorrect structures in equations i.e. $C_4H_{10}O + [O] \longrightarrow C_3H_7COH + H_2O$

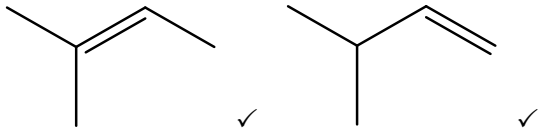
Mark Scheme

Question			Answer	Marks	Guidance
			Distillation to produce aldehyde/$CH_3CH_2CH_2CHO$ **AND** Reflux to produce carboxylic acid/$CH_3CH_2CH_2COOH$ ✓		scores equation mark Conditions **must** be linked to aldehyde/carboxylic acid or correct products. Conditions may be written above arrow of equation.
			Total	**15**	

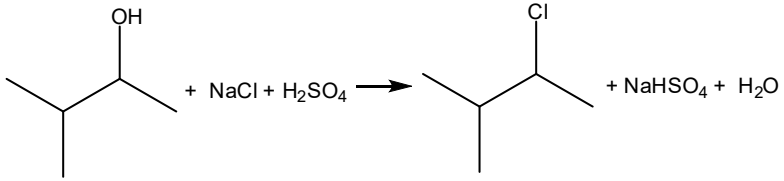
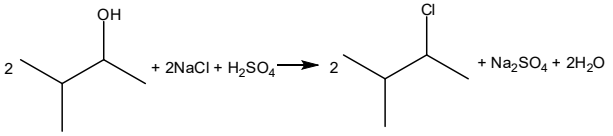
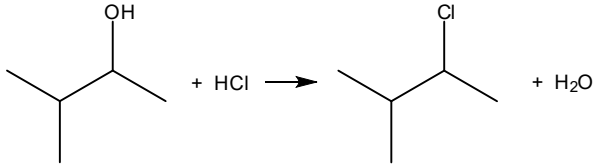
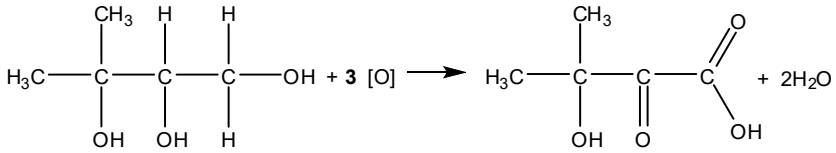
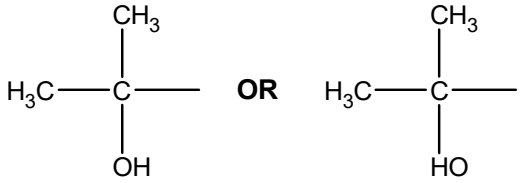
Mark Scheme

Question	Answer	Marks	Guidance
3	C	1	

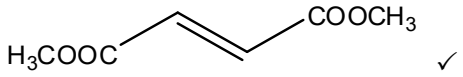
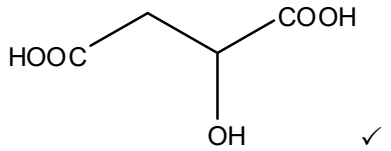
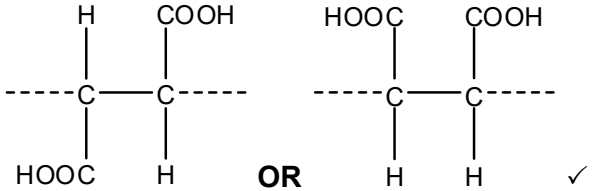
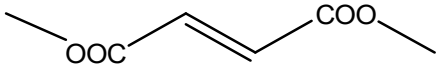
Mark Scheme

Question			Answer	Marks	Guidance
4	(a)	(i)	3-methylbutan-2-ol ✓	1	**IGNORE** lack of hyphens or addition of commas **ALLOW** 3-methylbutane-2-ol **DO NOT ALLOW** 2-methylbutan-3-ol **OR** 3-methylbut-2-ol **OR** 3-methbutan-2-ol **OR** 3-methybutan-2-ol **OR** 3-methlybutan-2-ol
		(ii)	$(CH_3)_2CHCHOHCH_3$ ✓	1	**ALLOW** brackets around OH e.g. $(CH_3)_2CHCH(OH)CH_3$ **ALLOW** any unambiguous structural formula e.g. $CH_3CH(CH_3)CHOHCH_3$ $CH_3CH(CH_3)CH(CH_3)OH$
		(iii)	One mark for each correct structure.  ✓ ✓	2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **ALLOW** in either order

Mark Scheme

Question			Answer	Marks	Guidance
		(iv)	 Correct haloalkane ✓ Correctly balanced equation ✓	2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **ALLOW** H^+ for H_2SO_4 **ALLOW** equations forming Na_2SO_4  **ALLOW** equations with HCl  **DO NOT ALLOW** equations that form NaOH
	(b)		 Correct organic product ✓ Rest of equation ✓	2	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **ALLOW any** vertical bond to the tertiary OH group e.g. **ALLOW** 

Mark Scheme

Question	Answer	Marks	Guidance
(c)	**Product from excess CH_3OH/H_2SO_4**  ✓ **Product from steam, H_3PO_4**  ✓ **Repeat unit of polymer C**  ✓	3	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous e.g  **IGNORE** connectivity in each product **ALLOW** the *E* or *Z* isomer as product from excess CH_3OH/H_2SO_4 'End bonds' **MUST** be shown (do not have to be dotted) **IGNORE** brackets **IGNORE** *n* **ALLOW** more than one repeat unit but has to be a whole number of repeat units
	Total	**11**	

Mark Scheme

Question	Answer	Marks	AO element	Guidance
5	A	1	1.1	
6	C	1	2.3	
7	D	1	2.1	
8	B	1	2.3	

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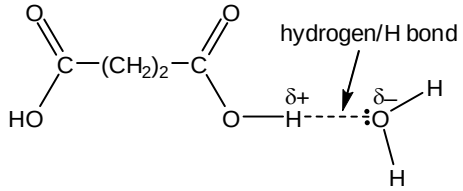
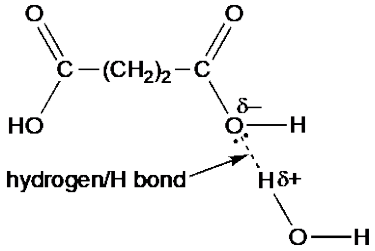
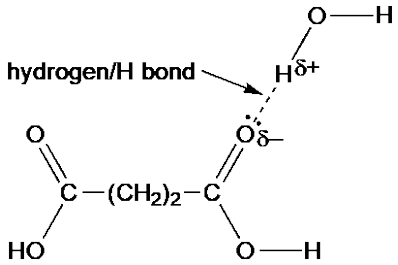
Question			Answer	Marks	AO element	Guidance
9	(a)	(i)	**Reagents** $K_2Cr_2O_7$ **AND** acid **AND** reflux ✓ **Equation** $HO(CH_2)_4OH + 4[O] \rightarrow HOOC(CH_2)_2COOH + 2H_2O$ [O] **AND** H_2O ✓ Correctly balanced equation ✓	**3**	**1.1** **2.5** **2.6**	**ALLOW** $Na_2Cr_2O_7$ **OR** $Cr_2O_7^{2-}$ **ALLOW** H_2SO_4 **OR** HCl **OR** H^+ **ALLOW** words. e.g. 'acidified dichromate' **ALLOW** a small slip in formula for dichromate e.g KCr_2O_7,
		(ii)	 **OR**  Diagram showing correct dipole charges on each end of one hydrogen bond between a water molecule and a diacid ✓ Hydrogen bond between one lone pair on O atom in one of the molecules and the H atom of another **AND** Hydrogen bonding stated or labelled on diagram	**2**	**2.1×2**	**ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous **DO NOT ALLOW** δ+ on H atoms of CH_2 group **ALLOW** H-bond for hydrogen bond **ALLOW** H bond between C=O and H_2O, i.e.  **IF** diagram is not labelled, **ALLOW** hydrogen bond/H bond from text

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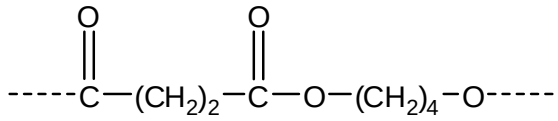
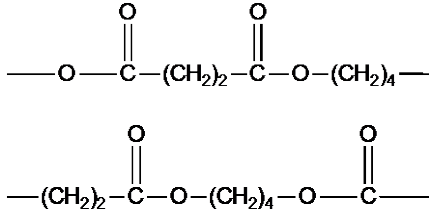
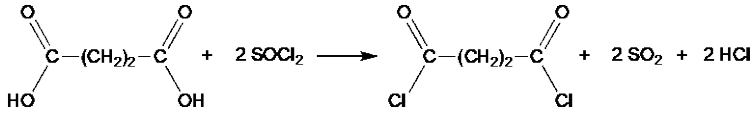
Question			Answer	Marks	AO element	Guidance
	(b)	(i)	 Ester link (must be displayed) ✓ Rest of structure ✓	2	1.2 2.5	**ALLOW** the 'O' or C=O at either end, e.g.  **IGNORE** brackets **IGNORE** *n* End bonds' **MUST** be shown (solid or dotted) **DO NOT ALLOW** more than one repeat unit
		(ii)	the ester/ ester bond/ ester group /polyester can be broken down ✓ **OR** It can be hydrolysed ✓	1	3.2	**IGNORE** references to photodegradable 'Bond breaks' is not sufficient – no reference to ester bond
		(iii)	 $SOCl_2$ in equation ✓ Structure of diacyl dichloride ✓ Complete balanced equation ✓	3	1.1 1.2 2.6	**ALLOW** alternative approach using PCl_5 or PCl_3