EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed
85 Minutes

Score /71

Percentage %

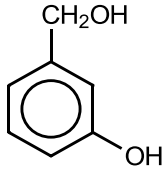
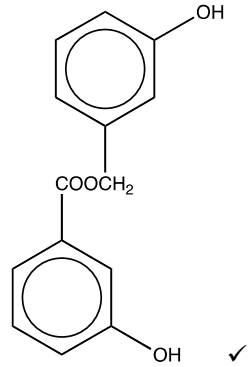
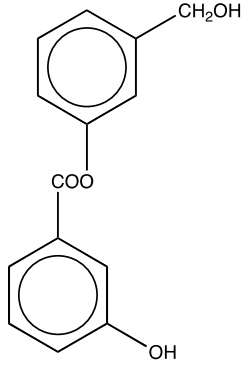
CHEMISTRY

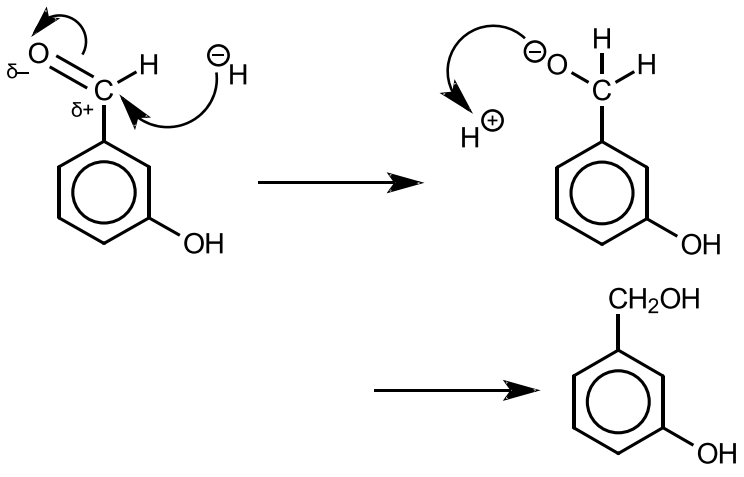
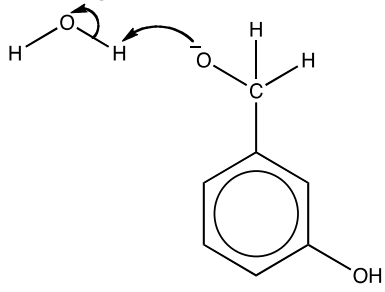
OCR AS & A LEVEL

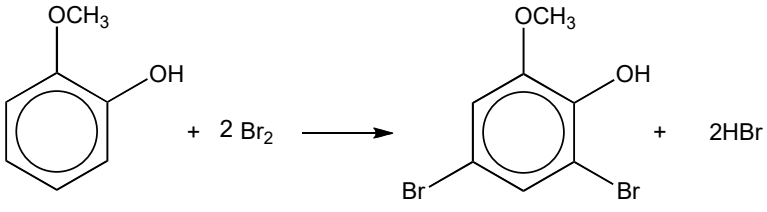
Mark Scheme

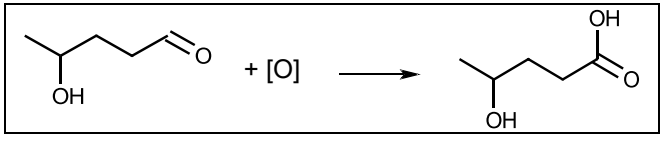
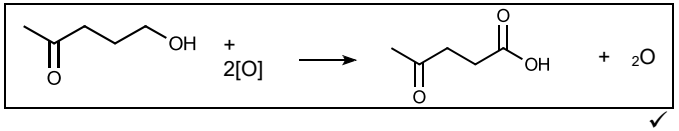
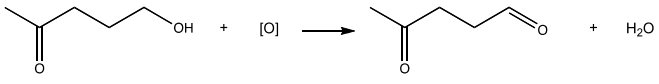
Module 6: Organic chemistry and analysis

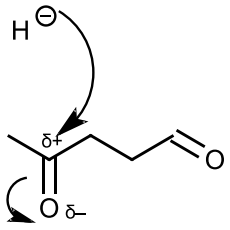
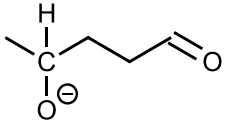
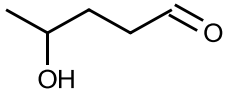
Question			Answer	Mark	Guidance
1	(a)		(Relative) solubility (in stationary phase) ✓	1	**ALLOW** how well the compound dissolves **IGNORE** retention time **AND** partition **DO NOT ALLOW** adsorption **OR** absorption
	(b)	(i)	Compound **B** **AND** M^+/molecular ion peak (at *m*/*z*) = 124 ✓	1	**ALLOW** Mr = 124 **IGNORE** compound B because *m*/*z* = 124 **ALLOW** $C_7H_8O_2^+ = 124$ **OR** $C_7H_8O_2 = 124$ **ALLOW** peak at (m/z =) 109 due to $HOC_6H_4O^+$ **ALLOW** peak at (m/z =) 109 due to loss of CH_3 **IGNORE** reference to other peaks in the spectrum
		(ii)	Compound (B) is less soluble in the stationary phase/ liquid	1	**ORA** Answer refers to the first compound to emerge from the column **ALLOW** compound (B) is more soluble in mobile phase/gas **ALLOW** compound interacts less with stationary phase/liquid **OR** compound interacts more with mobile phase/gas **IGNORE** compound adsorbs less **IGNORE** compound is not very soluble (comparison needed) **IGNORE** volatility **OR** reactivity

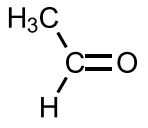
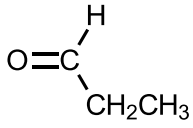
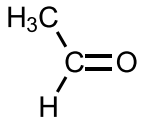
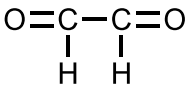
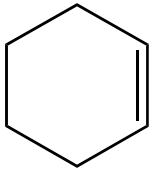
Question			Answer	Mark	Guidance
	(c)	(i)	reagent = $K_2Cr_2O_7$ **AND** H_2SO_4 ✓	3	**ALLOW** acidified dichromate **ALLOW** H^+/any acid **IGNORE** concentration of acid **ALLOW** $Na_2Cr_2O_7$ /$Cr_2O_7^{2-}$ /(potassium **OR** sodium) dichromate((VI)) **ALLOW** acidified MnO_4^- **ALLOW** Tollens' reagent/ammoniacal silver nitrate **IGNORE** conditions
			compound C =  ✓		**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous **ALLOW ECF** from incorrect **compound C** Check positions of OH groups
			ester =  ✓		**ALLOW** esterification of phenol group 

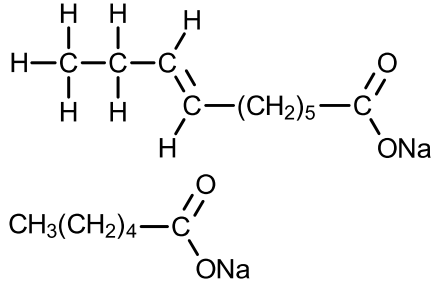
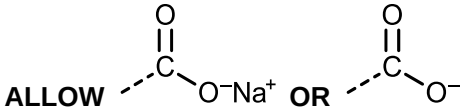
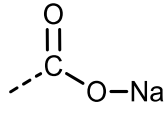
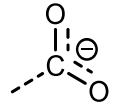
Question	Answer	Mark	Guidance
(ii)	curly arrow from H^- to $C^{\delta+}$ ✓ dipole **AND** curly arrow from C=O bond to O ✓ correct intermediate **AND** curly arrow to H^+ ✓  	3	**ANNOTATE ANSWER WITH TICKS AND CROSSES ETC** curly arrow must come from lone pair on H or negative charge on H curly arrow must come from the bond, not the carbon atom curly arrow must come from lone pair on O or negative charge on O and go to H or positive charge on H **Where circles have been placed round charges, this is for clarity only and does not indicate a requirement** **ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous **ALLOW** for second stage  **IF** H_2O is used it **MUST** show the curly arrow from the negative charge or lone pair on the oxygen atom of the intermediate to H in H_2O **AND** from the O—H bond to the O in H_2O. **Dipole not required on water molecule** Penalise missing –OH on intermediate only **IGNORE** product – already given credit in part (i)

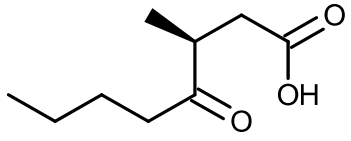
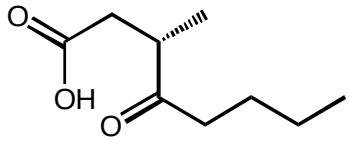
Question			Answer	Mark	Guidance
	(d)		 ✓	1	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous **ALLOW** disubstitution at any positions on benzene ring
			Total	**10**	

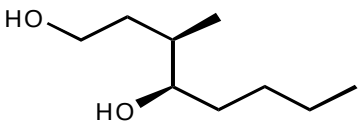
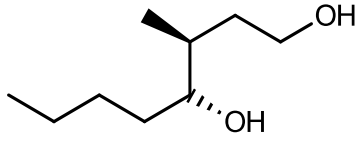
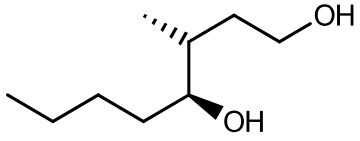
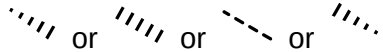
Question			Answer	Mark	Guidance
2	(a)		**FIRST** react **all** with Tollens' reagent **AND** silver mirror/ppt/solid (formed) with compound **D** **OR** with Fehling's/Benedict's solutions **AND** (brick-red/orange) solid/precipitate (formed) with compound **D** ✓ ***NOTE**: eliminates **D***  ✓ **THEN** react **C** and **E** with H_2SO_4/H^+ **AND** $K_2Cr_2O_7$/ $Cr_2O_7^{2-}$/$Na_2Cr_2O_7$ **AND** colour change **OR** green colour with compound **C** **OR** no change **OR** no reaction **OR** no green colour with compound **E** ✓  ✓	4	**ALLOW** ammonia + silver nitrate for reagent **ALLOW** black solid/ppt **ALLOW** 'the aldehyde gives a silver mirror' **ALLOW** solid **OR** crystals **OR** ppt as alternatives for precipitate **ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **DO NOT ALLOW** molecular formulae for organic structures **IGNORE** all references to 2,4-dinitrophenylhydrazine/Brady's **ACCEPT** acidified dichromate **ALLOW** blue/green blue **IGNORE** equation for oxidation of **D** **ALLOW** equation for partial oxidation 

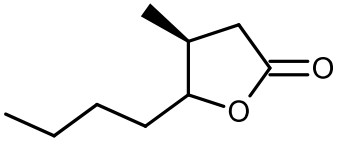
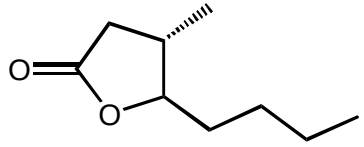
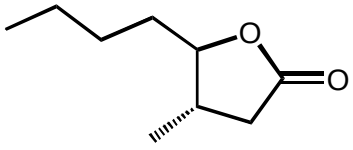
Question			Answer	Mark	Guidance
					ALLOW alternative sequences e.g. **FIRST** react **all** with H_2SO_4 **AND** $K_2Cr_2O_7$ colour change with **C** and **D** *eliminates **E*** At least one correct equation and structure of one product from either reaction required for the second mark. **NB** several possible products for the oxidation of **D** **THEN** react **C** and **D** with Tollens' …… *distinguishes between **C** and **D***
2	**(b)**		 curly arrow from H^- to $C^{(\delta+)}$ of correct C=O group ✓ dipole correct **AND** curly arrow from C=O bond to $O^{(\delta-)}$ ✓  correct intermediate with negative charge on O ✓  correct product ✓	**4**	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous First curly arrow must come from either a lone pair on H or negative charge on H **IF** aldehyde reduced **OR** both carbonyls reduced **DO NOT AWARD** first mark (second, third and fourth marks can be awarded **ECF**) **IGNORE** lack of C—H if entirely skeletal **IGNORE** curly arrows in second stage Apply ecf to error in structure e.g. CH_2 missing from the chain or –COOH/-COH instead of –CHO **IGNORE** other products

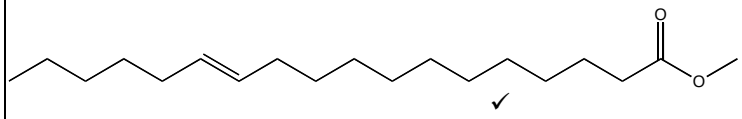
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>2</td><td>(c)</td><td></td><td>
<table>
<tr><th>Compound</th><th>C</th><th>D</th><th>E</th></tr>
<tr><td>Number of peaks</td><td>5</td><td>5</td><td>4</td></tr>
</table>
all correct ✓</td><td>1</td><td></td></tr>
<tr><td>2</td><td>(d)</td><td>(i)</td><td>• pent-2-ene  AND  ✓
• hexa-2,4-diene  ✓  ✓</td><td>3</td><td>ALLOW correct structural OR displayed OR skeletal formulae OR combination of above as long as unambiguous
ALLOW C_2H_5CHO and CH_3CHO</td></tr>
<tr><td>2</td><td>(d)</td><td>(ii)</td><td>  ✓</td><td>1</td><td>ALLOW correct structural OR displayed OR skeletal formulae OR combination of above as long as unambiguous</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>13</td><td></td></tr>
</table>

Question			er	Marks	Guidance
3	(a)	(i)	propane-1,2,3-triol ✓	1	**ALLOW** absence of 'e' after 'propan' **ALLOW** 1,2,3-propanetriol **ALLOW** absence of hyphens 1, 2 and 3 must be clearly separated: **ALLOW** full stops: 1.2.3 **OR** spaces: 1 2 3 **DO NOT ALLOW** 123 **IGNORE** glycerol
		(ii)	 One mark for decenoate salt **OR** decenoic acid ✓ One mark for hexanoate salt **OR** hexanoic acid ✓ One mark for **BOTH correct** products shown as salts (with or without Na^+) ✓	3	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous **DO NOT ALLOW** *cis* structure  **DO NOT ALLOW**  (covalent bond)  **ALLOW** delocalised carboxylate **IGNORE** glycerol
	(b)		one of the fatty acids is *trans* ✓ which may increase / cause / produce (the level of) 'bad'/LDL cholesterol ✓ **QWC** cholesterol MUST be spelt correctly	2	**ALLOW** one of the products is TRANS **ALLOW** reduces (the level of) 'good'/HDL cholesterol
			Total	**6**	

Question			Answer	Marks	Guidance
4	(a)	(i)	**F** =  **AND** reagent $NaBH_4$ ✓ **NB One mark for BOTH**	1	**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** combination of above as long as unambiguous Wedge out of the paper is required i.e.( or  or ) **DO NOT ALLOW** dashed wedge on methyl group in this orientation ( or  or  or ) **ALLOW** 
		(ii)	Colour changes from orange to green / blue / green blue ✓	1	
		(iii)	to ensure carboxylic acid is formed **OR** prevents formation of aldehyde **OR** distillation only makes the aldehyde ✓	1	
		(iv)	(nucleophilic) addition ✓	1	**ALLOW** redox **OR** reduction
	(b)		2,4-DNP(H) ✓ orange precipitate ✓	2	**ALLOW** Brady's (reagent) **ALLOW** orange/red/yellow for colour of the 2,4-DNP(H) precipitate **ALLOW** solid/crystals in place of precipitate **IGNORE** any reference to recrystallising/melting points

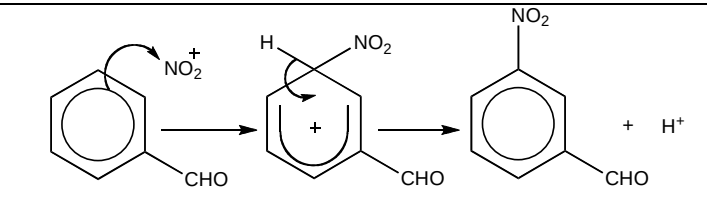
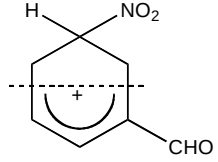
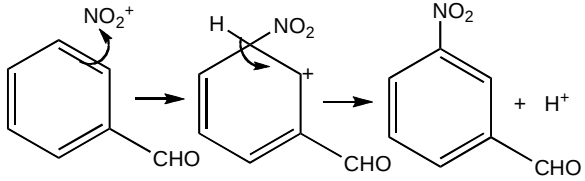
Question			Answer	Marks	Guidance
4	(c)	(i)	One of:  **OR**  **OR**  for one mark ✓ optical (isomerism) ✓	2	For bold wedge **ALLOW**  For dashed wedge **ALLOW**  **DO NOT ALLOW** any other representation of the structure, *i.e.* anything not skeletal **ALLOW** open wedges **ALLOW** isomers shown in any alternative correct orientation
		(ii)	If answer = 63.5 award 3 marks moles of **E** used = 4.56/160(.0) / 0.0285 (mol) ✓ moles of **G** formed = 3.15/174(.0) / 0.0181 (mol) ✓ yield = 0.0181/0.0285 × 100% / 63.5% ✓	3	0.0285 mol is exact calculator value 0.0181 mol is to 3sf (calculator value 0.0181034…) **IGNORE** trailing numbers in this answer **ALL ANSWERS MUST** be to a minimum of 3sf, the final answer must be to 3 sf (calculator value gives 63.520871%) (rounding of moles of **G** gives 63.508772%) **ALLOW** ecf from incorrect Mr or moles unless the yield is >100

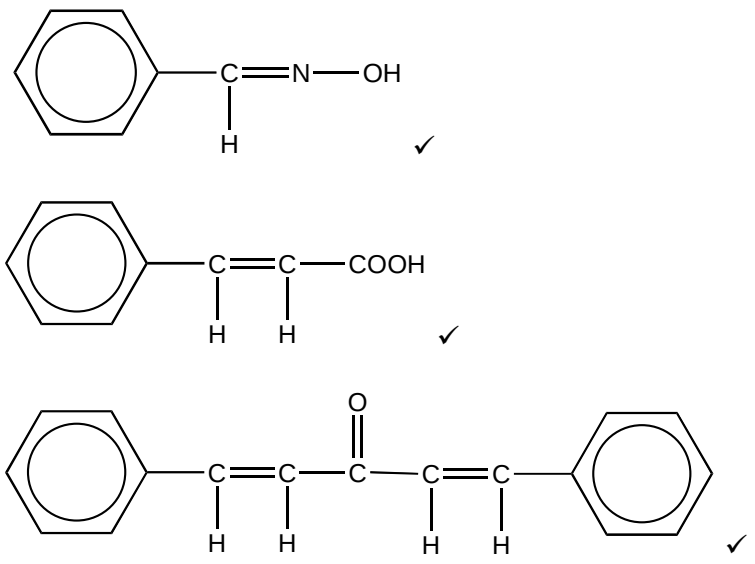
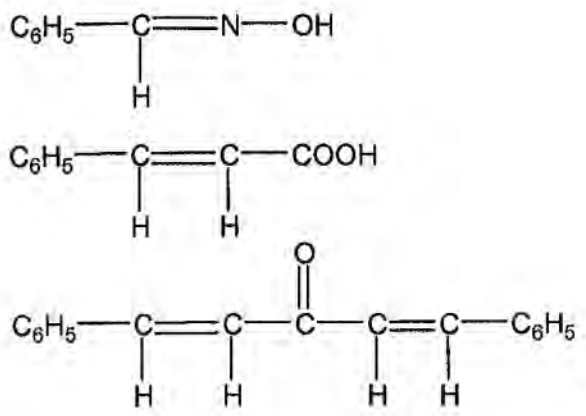
Question			Answer	Marks	Guidance
		(iii)	 for first mark ✓ Other product = H_2O for second mark ✓	2	**ALLOW** abbreviation of alkyl chain Wedge out of the paper is required i.e.( or  or ) **DO NOT ALLOW** dashed wedge on methyl group in this orientation ( or  or  or ) **ALLOW**  Be careful with orientation of lactone: **ALLOW** 
			Total	**13**	

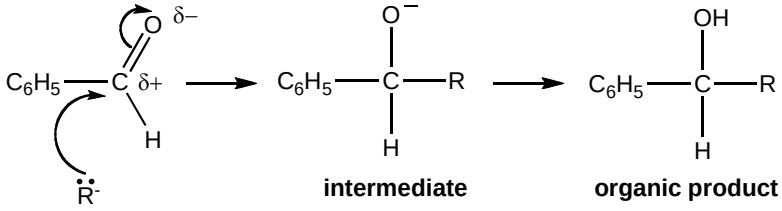
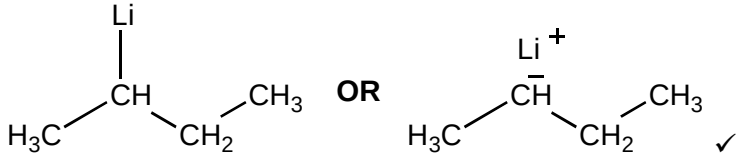
Question			er	Marks	Guidance
5	(a)	(	 ✓ *cis*-isomer has Hs on same side **OR** *cis*-isomer has branches on same side **OR** *cis*-isomer has same groups on same side **OR** *cis*-isomer has lowest priority groups on same side **OR** *cis*-isomer has highest priority groups on same side ✓	2	**ALLOW** *trans*-isomer has Hs on opposite sides **OR** *trans*-isomer has branches on opposite sides **OR** *trans*-isomer has same groups on opposite sides **DO NOT ALLOW** 'similar groups' for 'same groups' **OR** *trans*-isomer has lowest priority groups on opposite sides **OR** *trans*-isomer has highest priority groups on opposite sides ✓ For explanation, **ALLOW** a clear diagram, *ie*:  *cis* **ALLOW** response in terms of packing, e.g. molecules/chains of *trans*-isomer pack close together **OR** molecules/chains of *cis*-isomer do **not** pack closely together **DO NOT ALLOW** 'carbon atoms' for 'molecules/chains'
		(ii)	heart disease**/**strokes ✓	1	**ALLOW** any named heart/circulatory complaint e.g. atheroma, atherosclerosis **ALLOW** increase in **bad** cholesterol/LDL **ALLOW** high in LDLs **ALLOW** fat lining arteries **ALLOW** high blood pressure **ALLOW** hypertension **IGNORE** reference to HDLs and cholesterol on its own

Question			er	Marks	Guidance
	(b)	(	27	1	
		(ii)	8	1	
	(c)	(	alcohol ✓ ester ✓	2	**IGNORE** OH **OR** hydroxyl **OR** hydroxy **DO NOT ALLOW** phenol **OR** hydroxide **IGNORE** COOR **IF** there is a list with more than two responses, mark wrong responses first, e.g. alcohol, ketone **X**, ether **X** zero marks alcohol ✓, ester, methyl **X** 1 mark ester, hydroxide **X**, ketone **X** zero marks ester ✓, hydroxyl I, ketone **X** 1 mark
		(ii)	ensures correct chirality ✓	1	**ALLOW** enantiomer for optical isomer **ALLOW** produces only one **optical** isomer **ALLOW** stops need/cost/difficulty of separating **optical** isomers **ALLOW** stops formation of the **optical** isomer which may have (harmful) side effects **DO NOT ALLOW** lower doses/dosage needed **DO NOT ALLOW** forms one stereoisomer (could be *E*/Z) **DO NOT ALLOW** stereoselectivity

Question			er	Marks	Guidance
		(iii)	**1st step** *reagent*: $NaBH_4$ ✓ *functional groups*: **alde yde** forms an **alcohol** ✓ *names required* **2nd step** Marks **ONLY** available from correct **hydroxycarboxylic acid** formed in 1st step *reagent*: Acid **OR** H^+ (catalyst) ✓ *functional groups*: **alcoho** and **carboxylic acid / carboxyl group** form an **ester** ✓ *names required*	4	***ANNOTATIONS MUST BE USED*** **ALLOW** H_2/Ni (catalyst) **DO NOT ALLOW** $LiAlH_4$ (*because $LiAlH_4$ reduces COOH*) **IGNORE** type of reaction or conditions **IGNORE** CHO **OR** OH **IGNORE** carbonyl **OR** hydroxyl **OR** hydroxy **DO NOT ALLOW** phenol **OR** hydroxide **ALLOW** named acid/correct formula **IGNORE** dilute/concentrated **IGNORE** OH, COOH, COO, **IGNORE** hydroxyl **OR** hydroxy **DO NOT ALLOW** phenol **OR** hydroxide
			Total	**12**	

Question			er	Marks	Guidance
6	(a)		 curly arrow from ring to NO_2^+ **M1** ✓ correct intermediate curly arrow from C-H bond back to reform ring **M2** ✓ **M3** ✓ correct products **M4** ✓ --- **Note**: **ALLOW M1**, **M2 AND M3** for benzene **OR ANY** substituted benzene compound For **M4**, credit **ONLY** the **correct** products --- $HNO_3 + H_2SO_4 \longrightarrow NO_2^+ + H_2O + HSO_4^-$ ✓ $H^+ + HSO_4^- \longrightarrow H_2SO_4$ ✓ **OR** $HNO_3 + 2H_2SO_4 \longrightarrow NO_2^+ + H_3O^+ + 2HSO_4^-$ ✓ $H^+ + HSO_4^- \longrightarrow H_2SO_4$ ✓ **OR** $HNO_3 + H_2SO_4 \longrightarrow H_2NO_3^+ + HSO_4^-$ **AND** $H_2NO_3^+ \longrightarrow NO_2^+ + H_2O$ ✓ $H^+ + HSO_4^- \longrightarrow H_2SO_4$ ✓	6	***ANNOTATIONS MUST BE USED*** --- **Mark 1 (M1)** **ALLOW** curly arrow from the ring **OR** from within the ring --- **Mark 2 (M2)** – intermediate showing delocalisation over less than 6 carbons with the correct orientation **BUT DO NOT ALLOW** intermediate with π system less than halfway up:  --- **Mark 3 (M3)** curly arrow from C–H bond reforming π-delocalised ring in benzene **ALLOW** Kekulé mechanism:  **ALLOW** double bonds shown in other Kekulé arrangement --- **Mark 4 (M4)** **BOTH** correct products: **3**-nitrobenzaldehyde **AND** H^+

Question			er	Marks	Guidance
	(b)		$2\ C_6H_5CHO + KOH \longrightarrow C_6H_5CH_2OH + C_6H_5COOK$ **OR** $2\ C_6H_5CHO + OH^- \longrightarrow C_6H_5CH_2OH + C_6H_5COO^-$ 1 mark for $C_6H_5CH_2OH$ ✓ 1 mark for C_6H_5COOK **OR** C_6H_5COOH **OR** $C_6H_5COO^-$ ✓ 1 mark for complete fully correct balanced equation (i.e. as above) ✓	3	**ALLOW** correct structural **OR** displayed **OR** skeletal formula **ALLOW** combination of formulae as long as unambiguous **ALLOW** use of NaOH instead of KOH throughout, i.e. $2\ C_6H_5CHO + NaOH \rightarrow C_6H_5CH_2OH + C_6H_5COONa$ **ALLOW** $C_6H_5COO^-K^+$
	(c)		 ✓	3	**ALLOW** correct structural **OR** displayed **OR** skeletal formula **ALLOW** combination of formulae as long as unambiguous e.g. **ALLOW** 

Question			er	Marks	Guidance
	(d)	(	 **intermediate** **organic product** 1 mark for curly arrow from R^- to C of C=O (lone pair not necessary) ✓ 1 mark for correct dipoles on C=O **AND** curly arrow from double bond to $O^{\delta-}$ ✓ 1 mark for correct intermediate with – charge on O ✓ 1 mark for correct product ✓	4	***ANNOTATIONS MUST BE USED*** **IGNORE** connectivity on OH of product Curly arrow **MUST** start from – sign of R^- **OR** from lone pair on R^- lone pair **does not need** to be shown on R^- **IGNORE** any curly arrows shown for **stage 2** i.e. in intermediate
		(ii)	 **OR** ✓	1	**ALLOW** correct structural **OR** displayed **OR** skeletal formula **ALLOW** combination of formulae as long as unambiguous **IGNORE** C_4H_9Li **OR** $C_4H_9^-Li^-$
			Total	**17**	