

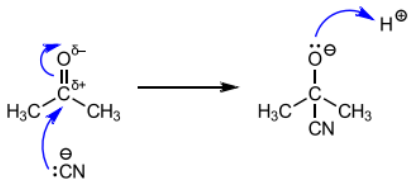

17. Carbonyl compounds

17.1 Aldehydes and ketones

Paper 2

Marking Scheme


Q1.

(a)(i)	 <ul style="list-style-type: none"> • curly arrow from lone pair on C of CN⁻ to carbonyl C • correct dipole on C=O • curly arrow from C=O bond to O • correct intermediate (the lone pair(s) not needed for this bullet point) • curly arrow from lone pair on —O⁻ to (source of) H⁺ 	1
		1
		1
(a)(ii)	<p>A's central carbon atom is not bonded to four different atoms/groups of atoms</p> <p>A</p> 	1
(c)(i)	$\text{CH}_3\text{COCH}_3 + 2[\text{H}] \rightarrow \text{CH}_3\text{CH}(\text{OH})\text{CH}_3$	1
(c)(ii)	propan-2-ol	1
(d)	red / orange / yellow ppt	1
(e)	Fehling's solution cannot oxidise ketones OR ketones are not easily oxidised	1

Q2.

(d)(iii)	<table border="1"> <thead> <tr> <th>reagent</th> <th>observation with F</th> </tr> </thead> <tbody> <tr> <td>2,4-DNPH</td> <td>red / orange / yellow ppt</td> </tr> <tr> <td>Tollens' reagent</td> <td>silver mirror OR grey ppt OR black ppt</td> </tr> <tr> <td>alkaline I₂(aq)</td> <td>yellow ppt</td> </tr> </tbody> </table>	reagent	observation with F	2,4-DNPH	red / orange / yellow ppt	Tollens' reagent	silver mirror OR grey ppt OR black ppt	alkaline I ₂ (aq)	yellow ppt	3
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2,4-DNPH	red / orange / yellow ppt									
Tollens' reagent	silver mirror OR grey ppt OR black ppt									
alkaline I ₂ (aq)	yellow ppt									

Q3.

(b)(i)	carbonyl (group)	1
(b)(ii)		2

Q4.

(c)(i)	carbonyl	1
(c)(ii)	CHI ₃	1

Q5.

(e)(i)	yellow precipitate	1
(e)(ii)	Iodine / I ₂	1
(e)(iii)	$C_6H_{12}O + 2[H] \rightarrow C_6H_{14}O$	1

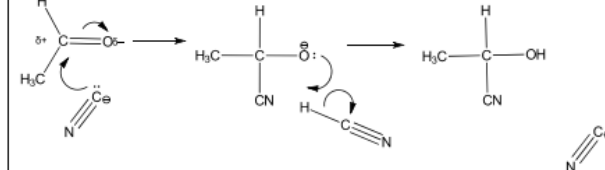
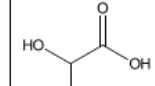
Q6.

(c)(i)	carbonyl / aldehyde / ketone	1
(c)(ii)	tertiary halogenoalkane	1

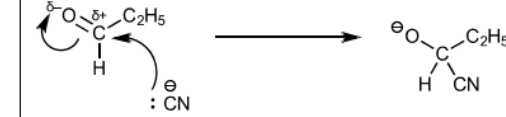
Q7.

(d)	M1 reagent (2,4-) DNPH / (2,4)-dinitrophenylhydrazine M2 observation yellow / orange / red precipitate	2
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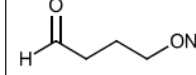
Q8.

(b)(i)	<p><i>mechanism for ethanal and HCN using CN⁻ (from KCN) as the catalyst</i></p>  <p>M1 arrow from lone pair of electrons on :CN⁻ to C of C=O M2 correct dipole on C^{δ+}=O^{δ-} AND arrow from the double bond to or beyond the O of C=O M3 arrow from lone pair of electrons on O of intermediate to H of HCN AND arrow from H-C bond to C of H-C≡N</p>	3
(b)(ii)	<p>ALLOW in any order M1 nitrile M2 (secondary) alcohol</p>	2
(b)(iii)	 <p>ALLOW any unambiguous structure</p>	1

Q9.

(c)(iii)	 <p>M1: Presence of :CN (if bonding shown, must be unambiguous triple bond) M2: curly arrow from :CN lone pair to carbonyl carbon M3: correct dipole AND curly arrow from double bond to oxygen M4: correct intermediate drawn</p>	4
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Q10.

(a)(iii)	<p><i>structure of H</i></p>  <p>OR CHO(CH₂)₂CH₂O⁻ Na⁺</p>	1
(a)(iv)	(formation of) silver mirror / ppt	1
(b)(ii)	<p>M1: add aqueous alkaline iodine M2: G no change AND J yellow ppt</p>	2
(b)(iii)	reducing agent	1

Q11.


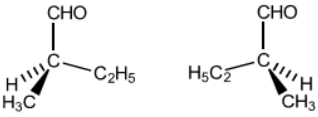
(d)(i)	A and B			1
(d)(ii)		Compound(s)	Observation	2
	Reaction with Tollens' reagent	B ✓	silver mirror OR grey / black / brown / silver precipitate ✓	
		Compound(s)	Observation	3
Reaction with alkaline aq. iodine	A ✓ and C ✓	(Pale) yellow precipitate /solid ✓		
	Compound(s)	Observation	3	
Reaction with sodium metal	C ✓ and D ✓	Effervescence / sodium/solid disappears ✓		

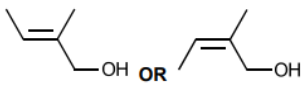
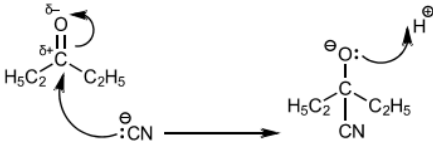
Q12.

(a)	M1 a lone pair / electron pair donor	1
	M2 (:):CN ⁻ / ⁻ (:):CN / cyanide ion	1

Q13.

(b)(i)	acidified potassium dichromate[(VI)] AND heat under reflux	1
(b)(ii)	M1: A has H-bonding (between molecules)	3
	M2: B only has dipole–dipole / VdW forces (between molecules)	
	M3: H-bonding is stronger / requires more energy to overcome	
(b)(iii)	$(\text{CH}_3)_3\text{CCHO} + 2[\text{H}] \rightarrow (\text{CH}_3)_3\text{CCH}_2\text{OH}$	1

(b)(iv)	 M1: / CH ₃ CH(OH)CH ₃ M2: H ₂ SO ₄ / sulfuric acid	2								
(c)(i)	<ul style="list-style-type: none"> orange / red / yellow precipitate orange / red / yellow precipitate 	1								
(c)(ii)	Aldehyde	1								
(c)(iii)	has a carbon / atom attached / bonded to four different atoms / groups / groups of atoms / chains	1								
(c)(iv)	 M1: Correct 3D representation M2: Correct 3D representation of drawn enantiomer	2								
(c)(v)	<table border="1"> <thead> <tr> <th>principal absorptions in the infra-red spectrum</th> <th>bond responsible</th> </tr> </thead> <tbody> <tr> <td>3200–3600 cm⁻¹</td> <td>RO-H / O-H</td> </tr> <tr> <td>1630 cm⁻¹</td> <td>C=C</td> </tr> <tr> <td>1050 cm⁻¹</td> <td>C—O</td> </tr> </tbody> </table>	principal absorptions in the infra-red spectrum	bond responsible	3200–3600 cm ⁻¹	RO-H / O-H	1630 cm ⁻¹	C=C	1050 cm ⁻¹	C—O	1
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3200–3600 cm ⁻¹	RO-H / O-H									
1630 cm ⁻¹	C=C									
1050 cm ⁻¹	C—O									

(c)(vi)	 M1: skeletal alkene group AND C5 structure M2: one alcohol group M3: branched chain AND capable of geometrical isomerism	3
(c)(vii)	M1: Correct structure of X and correct dipole on C=O M2: curly arrow from C=O bond to O AND intermediate with CN attached and –ve charge on the O M3: curly arrow from lone pair on CN ⁻ to C(=O) in X AND curly arrow from lone pair in the intermediate to H ⁺ 	3
(c)(viii)	catalyst	1