CAMBRIDGE INTERNATIONAL AS & A LEVEL CHEMISTRY · 9701

CHEMISTRY



MARK SCHEME

18 CARBOXYLIC ACIDS AND DERIVATIVES

SCORE	PERCENTAGE
/	%

STEMUP

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Paper 1 Multiple Choice Answers: Carboxylic Acids and Derivatives

Question	Paper	Q. No.	Answer
1084	9701_m22_qp_12	34	C
1085	9701_s21_qp_11	21	B
1086	9701_s21_qp_13	28	C
1087	9701_w21_qp_12	24	C
1088	9701_w21_qp_12	29	B
1089	9701_m20_qp_12	28	D
1090	9701_s20_qp_11	30	A
1091	9701_s20_qp_12	20	A
1092	9701_s20_qp_13	23	A
1093	9701_s20_qp_13	26	C
1094	9701_w20_qp_11	24	C
1095	9701_w20_qp_11	29	D
1096	9701_w20_qp_12	18	D
1097	9701_w20_qp_12	29	A
1098	9701_m19_qp_12	29	D
1099	9701_s19_qp_11	28	A
1100	9701_s19_qp_12	28	B
1101	9701_w19_qp_11	28	B
1102	9701_m18_qp_12	22	A
1103	9701_s18_qp_11	28	A
1104	9701_s18_qp_11	29	C
1105	9701_s18_qp_12	28	B
1106	9701_s18_qp_13	28	D
1107	9701_w18_qp_11	26	D
1108	9701_w18_qp_11	28	B
1109	9701_w18_qp_12	29	A
1110	9701_s17_qp_11	27	A
1111	9701_s17_qp_11	30	B
1112	9701_s17_qp_13	23	A
1113	9701_s17_qp_13	28	A
1114	9701_s17_qp_13	29	A
1115	9701_w17_qp_11	25	A
1116	9701_w17_qp_11	27	C
1117	9701_w17_qp_11	28	B
1118	9701_s16_qp_11	22	A
1119	9701_s16_qp_11	26	C
1120	9701_s16_qp_12	28	B
1121	9701_w16_qp_11	28	A
1122	9701_s15_qp_12	23	C
1123	9701_s15_qp_13	25	A
1124	9701_s15_qp_13	30	A
1125	9701_w15_qp_11	25	D
1126	9701_m22_qp_12	27	C
1127	9701_m22_qp_12	35	A
1128	9701_m21_qp_12	23	A
1129	9701_m21_qp_12	28	D

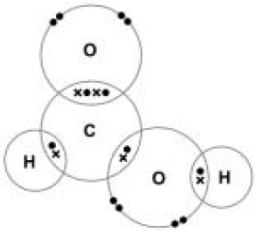
Paper 1 Multiple Choice Answers: Carboxylic Acids and Derivatives (co

Question	Paper	Q. No.	Answer
1130	9701_m21_qp_12	29	C
1131	9701_s21_qp_11	24	D
1132	9701_s21_qp_13	29	B
1133	9701_w21_qp_11	29	B
1134	9701_w21_qp_13	29	B
1135	9701_m20_qp_12	27	A
1136	9701_s20_qp_11	26	D
1137	9701_s20_qp_12	23	B
1138	9701_s20_qp_13	21	D
1139	9701_s19_qp_12	29	D
1140	9701_s19_qp_13	30	A
1141	9701_w19_qp_12	29	B
1142	9701_s18_qp_11	11	B
1143	9701_s18_qp_11	27	A
1144	9701_s18_qp_12	29	A
1145	9701_w18_qp_11	29	C
1146	9701_w18_qp_12	28	A
1147	9701_s17_qp_12	30	C
1148	9701_w17_qp_11	30	C
1149	9701_m16_qp_12	28	C
1150	9701_m16_qp_12	30	B
1151	9701_s16_qp_11	21	D
1152	9701_s16_qp_11	27	B
1153	9701_s16_qp_11	29	A
1154	9701_s16_qp_12	30	B
1155	9701_s16_qp_13	29	D
1156	9701_s16_qp_13	30	C
1157	9701_w16_qp_11	23	A
1158	9701_w16_qp_11	29	A
1159	9701_w16_qp_12	26	C
1160	9701_w16_qp_12	29	D
1161	9701_s15_qp_11	21	B
1162	9701_s15_qp_12	30	B
1163	9701_s15_qp_13	23	D
1164	9701_w15_qp_11	30	B
1165	9701_w15_qp_12	30	A

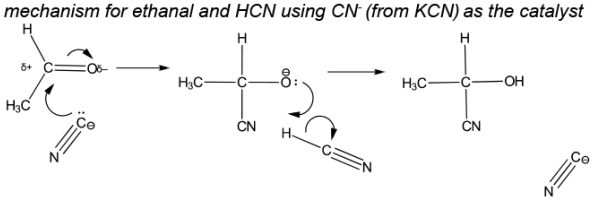
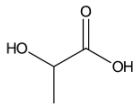
154. 9701_s21_ms_21 Q: 1

Question	Answer	Marks
(a)(i)	**option 1** **M1** the mass of a molecule OR the (weighted) average / (weighted) mean mass of the molecule(s)	1
	option 1 and **M2** relative / compared to 1 / 12 (the mass) of **an atom** of carbon–12	1
	OR on a scale in which a carbon–12 atom / isotope has a mass of (exactly) 12 (units) **option 2** **M1** mass of one mol of molecules	
	option 2 **M2** relative / compared to 1 / 12 (the mass) of 1 mol of C-12 OR which one mol C-12 (atom / isotope) has a mass of (exactly) 12 g	
(a)(ii)	CO_2H	1
(a)(iii)	$0.18/90 \times 2 \times 6.02 \times 10^{23} = 2.408 \times 10^{21}$ (atoms) OR **2.4(1)** $\times$ **10^{21}** (atoms) **M1** no mole ethanedioic acid $0.18 / 90 = 0.0020$	1
	M2 no mole ethanedioic acid $\times 2$ $0.0020 \times 2 = 0.0040$	1
	M3 no mole ethanedioic acid $\times 6.02 \times 10^{23}$ 2.4×10^{21}	1
(b)(i)	$CaC_2O_4(s) \rightarrow CaO(s) + CO_2(g) + CO(g)$ **M1** correct formulae	1
	M2 balancing equation AND state symbols.	1
(b)(ii)	(thermal) decomposition OR disproportionation	1
(b)(iii)	calcium carbonate / $CaCO_3$	1

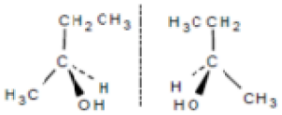
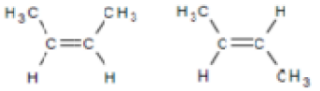
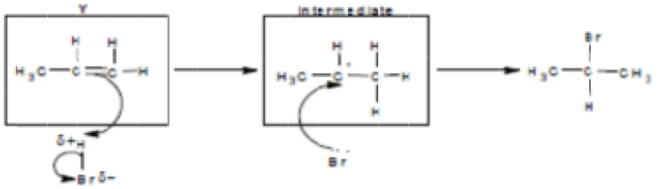
155. 9701_s21_ms_21 Q: 4

Question	Answer	Marks
(a)	Br / bromine as the oxidation number of Br decreases / goes from 0 → –1 OR bromine as it causes oxidation number of C (in methanoic acid) to increase / go from (+)2 → (+)4	1
(b)	(solution) turns (from brown / orange / red to) colourless / decolorises OR brown / orange / red fades	1
(c)(i)	rate = total change in concentration of Br_2 divided by time taken *calculation dependent on graph* *$(100 \times 10^{-5} - 12 \times 10^{-5}) / 600$* **M1** average rate of reaction 1.47×10^{-6}	1
	M2 units mol dm^{-3} s^{-1}	1
(c)(ii)	graph shown on same axes has steeper initial gradient AND reaches the same final $[Br_2]$	1
(c)(iii)	**M1** (at increased temp the average kinetic) energy of particles / species / molecules increases.	1
	M2 (many) more/greater proportion of particles with energy ⩾ E_a	1
(d)	 **M1** correct bonding electrons	1
	M2 correct number of non-bonding electrons around each oxygen	1

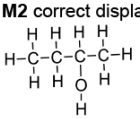
156. 9701_s20_ms_22 Q: 5

<table>
<tr><td>(a)</td><td>
<table>
<tr><th>Rxn.</th><th>name of mechanism</th><th>Name of reagents and conditions</th></tr>
<tr><td>1</td><td>M1 electrophilic addition</td><td>M2 steam AND
concentrated phosphoric acid (catalyst)</td></tr>
<tr><td>2</td><td></td><td>M3 & M4 Two marks for name of reagent and both conditions.
One mark for name of reagent and one conditions
acidified potassium dichromate ((VI))
condition 1 warm
condition 2 distil NOT reflux</td></tr>
<tr><td>6</td><td>M5 nucleophilic substitution</td><td>M6
ammonia (alcoholic) AND
heat in a sealed tube / heat under pressure</td></tr>
</table>
</td><td>6</td></tr>
<tr><td>(b)(i)</td><td>mechanism for ethanal and HCN using CN^- (from KCN) as the catalyst

M1arrow from lone pair of electrons on $:CN^-$ to C of C=O
M2 correct dipole on $C^{\delta+}=O^{\delta-}$ 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</td><td>3</td></tr>
<tr><td>(b)(ii)</td><td>ALLOW in any order
M1 nitrile
M2 (secondary) alcohol</td><td>2</td></tr>
<tr><td>(b)(iii)</td><td>
ALLOW any unambiguous structure</td><td>1</td></tr>
</table>

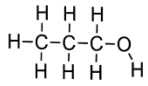
157. 9701_w15_ms_22 Q: 4

(a) (i)	Nucleophilic Substitution	[1]
(ii)	Has a chiral centre / carbon OR has a carbon / C attached to 4 different groups / atoms / chains OR has no plane / line of symmetry	[1]
(iii)		[1+1]
(iv)	Elimination	[1]
(v)	 *cis*-but-2-ene *trans*-but-2-ene	[1] [1]
(vi)	But-1-ene 2 Hs on one of the double-bonded Cs OR does not have 2 different groups on both atoms / each atom in C=C	[1] [1]
(b) (i)	ammonia / NH_3	[1]
(ii)	propanoyl chloride / C_2H_5COCl	[1]
(iii)	$CH_3CH(NHCOC_2H_5)CH_3$	[1]
(iv)	Reduction $LiAlH_4$ / $NaBH_4$ / H_2 and Ni / tin and concentrated HCl	[1] [1]
(v)	aluminium oxide	[1]
(vi)	 M1 = correct structure of **Y** and curly arrow from double bond to H M2 = dipole and curly arrow from H-Br bond to Br M3 = correct intermediate M4 = Br^- with lone pair and curly arrow from lone pair to C(+)	[1] [1] [1] [1]
(vii)	electrophilic addition	[1]
(viii)	secondary carbocation more stable than primary due to electron releasing character / (positive) inductive effect of alkyl groups	[1] [1]

158. 9701_s20_ms_23 Q: 5

(a)(i)	dehydration	1
(a)(ii)	**M1** correct identification of butan-2-ol **M2** correct displayed formula including correct connectivity of C–O–H 	2
(a)(iii)	isomer / name C / cis but-2-ene D / trans but-2-ene E / but -1-ene 2 marks for 3 correct names 1 mark for 2 correct names	2
(b)(i)	F – **M1** Ester / $RCOOR^{(')}$ / $RCO_2R^{(')}$ G – **M2** Carboxyl / carboxylic acid / RCOOH H – **M3** Alcohol / hydroxy / R-OH	3
(b)(ii)	triiodomethane	1
(b)(iii)	**M1 G** = HCOOH / HCO_2H **M2 H** = C_2H_5OH	2

159. 9701_s19_ms_22 Q: 5

(a)(i)	(n–)propyl ethanoate	1
(a)(ii)	NaOH / sodium hydroxide	1
a(iii)		1
(a)(iv)	perfume / solvent	1
(b)(i)	**M1** *divide by* A_r — C: 54.5 / 12; H: 9.1 / 1; O: 36.4 / 16	1
	M2 *divide by smallest number* — 4.54 / 2.275 (= 2 OR 1.99); 9.1 / 2.275(=4); 2.275 / 2.275 (=1)	1
	M3 *empirical formula based on correctly rounded values of M2*: C_2H_4O	1
(b)(ii)	(relative) molecular mass / M_r	1
(c)(i)	$C_3H_6O_2$	1
(c)(ii)	X and Z – no reaction / no (visible) change	1
	Y – effervesces	1
(d)	$2HCO_2H + Na_2CO_3 \rightarrow 2HCO_2Na + CO_2 + H_2O$	1