CAMBRIDGE INTERNATIONAL AS & A LEVEL CHEMISTRY · 9701

# CHEMISTRY



## MARK SCHEME

### 16 HYDROXY COMPOUNDS

| SCORE | PERCENTAGE |
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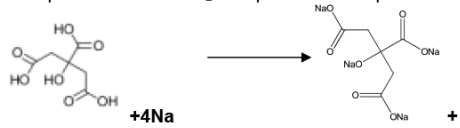
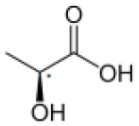
# Paper 1 Multiple Choice Answers: Hydroxy Compounds

| Question | Paper | Q. No. | Answer |
|---|---|---|---|
| 933 | 9701_m22_qp_12 | 29 | B |
| 934 | 9701_m21_qp_12 | 21 | C |
| 935 | 9701_s21_qp_11 | 25 | A |
| 936 | 9701_s21_qp_11 | 29 | C |
| 937 | 9701_s21_qp_12 | 26 | A |
| 938 | 9701_s21_qp_12 | 27 | C |
| 939 | 9701_s21_qp_12 | 29 | B |
| 940 | 9701_s21_qp_13 | 24 | D |
| 941 | 9701_s21_qp_13 | 25 | A |
| 942 | 9701_w21_qp_11 | 23 | B |
| 943 | 9701_w21_qp_11 | 24 | C |
| 944 | 9701_w21_qp_11 | 25 | A |
| 945 | 9701_w21_qp_12 | 26 | D |
| 946 | 9701_w21_qp_12 | 27 | A |
| 947 | 9701_w21_qp_13 | 25 | A |
| 948 | 9701_m20_qp_12 | 22 | B |
| 949 | 9701_m20_qp_12 | 26 | C |
| 950 | 9701_m20_qp_12 | 29 | B |
| 951 | 9701_s20_qp_11 | 25 | C |
| 952 | 9701_s20_qp_12 | 24 | A |
| 953 | 9701_s20_qp_13 | 22 | C |
| 954 | 9701_s20_qp_13 | 29 | C |
| 955 | 9701_w20_qp_11 | 26 | B |
| 956 | 9701_w20_qp_12 | 21 | C |
| 957 | 9701_w20_qp_12 | 24 | B |
| 958 | 9701_w20_qp_12 | 26 | D |
| 959 | 9701_m19_qp_12 | 25 | A |
| 960 | 9701_m19_qp_12 | 26 | D |
| 961 | 9701_m19_qp_12 | 27 | C |
| 962 | 9701_s19_qp_11 | 26 | C |
| 963 | 9701_s19_qp_11 | 27 | A |
| 964 | 9701_s19_qp_12 | 24 | D |
| 965 | 9701_s19_qp_13 | 26 | B |
| 966 | 9701_s19_qp_13 | 29 | C |
| 967 | 9701_w19_qp_11 | 5 | C |
| 968 | 9701_w19_qp_11 | 25 | C |
| 969 | 9701_w19_qp_11 | 29 | C |
| 970 | 9701_w19_qp_12 | 24 | C |
| 971 | 9701_w19_qp_12 | 25 | A |
| 972 | 9701_w19_qp_12 | 28 | C |
| 973 | 9701_s18_qp_11 | 21 | B |
| 974 | 9701_s18_qp_11 | 23 | B |
| 975 | 9701_s18_qp_11 | 24 | A |
| 976 | 9701_s18_qp_12 | 22 | A |
| 977 | 9701_s18_qp_12 | 26 | B |
| 978 | 9701_s18_qp_13 | 25 | B |

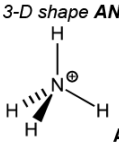
# Paper 1 Multiple Choice Answers: Hydroxy Compounds (continued)

| Question | Paper | Q. No. | Answer |
|---|---|---|---|
| 979 | 9701_s18_qp_13 | 26 | A |
| 980 | 9701_s18_qp_13 | 29 | B |
| 981 | 9701_w18_qp_11 | 23 | B |
| 982 | 9701_w18_qp_11 | 24 | D |
| 983 | 9701_w18_qp_12 | 26 | B |
| 984 | 9701_m17_qp_12 | 26 | C |
| 985 | 9701_m17_qp_12 | 27 | D |
| 986 | 9701_m17_qp_12 | 30 | C |
| 987 | 9701_s17_qp_11 | 24 | C |
| 988 | 9701_s17_qp_11 | 28 | C |
| 989 | 9701_s17_qp_12 | 6 | D |
| 990 | 9701_s17_qp_12 | 24 | D |
| 991 | 9701_s17_qp_12 | 25 | D |
| 992 | 9701_s17_qp_12 | 28 | A |
| 993 | 9701_s17_qp_13 | 26 | D |
| 994 | 9701_s17_qp_13 | 27 | B |
| 995 | 9701_s17_qp_13 | 30 | C |
| 996 | 9701_w17_qp_11 | 21 | A |
| 997 | 9701_w17_qp_12 | 26 | A |
| 998 | 9701_w17_qp_12 | 27 | C |
| 999 | 9701_w17_qp_12 | 28 | B |
| 1000 | 9701_w17_qp_12 | 30 | C |
| 1001 | 9701_m16_qp_12 | 23 | C |
| 1002 | 9701_m16_qp_12 | 26 | D |
| 1003 | 9701_m16_qp_12 | 27 | D |
| 1004 | 9701_s16_qp_12 | 29 | D |
| 1005 | 9701_s16_qp_13 | 20 | C |
| 1006 | 9701_s16_qp_13 | 26 | B |
| 1007 | 9701_s16_qp_13 | 27 | B |
| 1008 | 9701_s16_qp_13 | 28 | C |
| 1009 | 9701_w16_qp_11 | 25 | C |
| 1010 | 9701_w16_qp_11 | 30 | B |
| 1011 | 9701_w16_qp_12 | 27 | C |
| 1012 | 9701_s15_qp_11 | 27 | B |
| 1013 | 9701_s15_qp_12 | 20 | B |
| 1014 | 9701_s15_qp_12 | 21 | C |
| 1015 | 9701_s15_qp_12 | 24 | B |
| 1016 | 9701_s15_qp_12 | 26 | A |
| 1017 | 9701_s15_qp_13 | 20 | C |
| 1018 | 9701_w15_qp_12 | 20 | B |
| 1019 | 9701_w15_qp_12 | 25 | C |
| 1020 | 9701_w15_qp_12 | 26 | D |

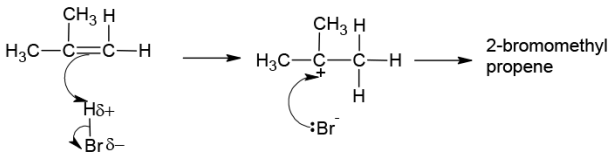
129. 9701_s21_ms_23 Q: 5

| Question | Answer | Marks |
|---|---|---|
| (a) | **M1** all 3 COOH form COONa / $CO_2Na$ / $COO^-Na^+$ | 1 |
| | **M2** the OH group forms CONa / $CO^-Na^+$ | 1 |
| | **M3** equation describes $H_2$ as a product and equation balanced correctly  **+4Na** **+ $2H_2$** ✓✓✓ OR $C(CH_2COOH)_2(COOH)(OH) + 4Na \rightarrow C(CH_2COONa)_2(COONa)(ONa) + 2H_2$ ✓✓✓ | 1 |
| (b)(i) | **M1** *skeletal formula of 2-hydroxypropanoic acid / similar chiral isomer that meet the criteria in table*  | 1 |
| | **M2** chiral carbon marked with * | 1 |
| (b)(ii) | **M1** citric acid has a tertiary alcohol group so is not oxidised | 1 |
| | **M2 X** has a secondary alcohol group which is oxidised (to a ketone) | 1 |
| (c) | **M1** chiral centre / non superimposable mirror image / has a C **attached** to 4 different groups | 1 |
| | **M2** C=C where each C is attached to (two) different groups | 1 |
| (d) | (molecules / isomers with) the same molecular formula / same number of atoms of each element AND different structural formulae / different structures | 1 |

130. 9701_w19_ms_22 Q: 3

| | | |
|---|---|---|
| (a)(i) | green gas fades<br>**OR**<br>white solid / white powder / white smoke / white fumes | **1** |
| (a)(ii) | hydrolysis | **1** |
| (a)(iii) | □ P goes from 0 to (+)5 / (+)V<br>□ P is oxidised<br>□ N goes from (+)5 / (+)V to (+)4 / (+)IV<br>□ N is reduced<br><br>Award one mark for two correct bullet points, award two marks for all four correct. | **2** |
| (b)(i) | accepts a proton / $H^+$<br>**OR**<br>donates a (lone) pair of $e^-$ | **1** |
| (b)(ii) | *3-D shape **AND** bond angle*<br><br>**AND** $109\frac{1}{2}$(°) | **1** |
| (b)(iii) | fertilisers | **1** |
| (c)(i) | $C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl + POCl_3 + HCl$ | **1** |
| (c)(ii) | substitution | **1** |
| (c)(iii) | EITHER<br>**M1:** HI / $I^-$ is a strong(er) reducing agent (than HCl / $Cl^-$)<br>**M2:** HI / $I^-$ is oxidised (to iodine but the chloride is not)<br><br>**OR**<br><br>**M1:** $H_2SO_4$ is a (strong enough) oxidising agent (to react with HI / $I^-$ here)<br>**M2:** HI / $I^-$ forms iodine<br><br>**OR**<br><br>**M1:** phosphoric acid is a weak / not an oxidising agent<br>**M2:** (so) does not react with iodide (where M2 is dependent on M1 here) | **2** |
| (c)(iv) | **M1:** $C_2H_5I$ reacts fastest AND $C_2H_5Cl$ reacts slowest **OR** $C_2H_5Cl < C_2H_5Br < C_2H_5I$<br><br>**M2:** C—I bond is the weak(est) AND C—Cl bond strong(est) | **2** |

131. 9701_s18_ms_21 Q: 4

| | | |
|---|---|---|
| (a)(i) | Iodoform / triiodomethane | 1 |
| (a)(ii) | butan-2-ol | 1 |
| (b) | $CH_3CH_2CH_2CH_2OH$<br>$(CH_3)_3COH$<br>$(CH_3)_2CHCH_2OH$ | 2 |
| (c)(i) | oxidation / redox | 1 |
| (c)(ii) | acidified / $H^+$<br>**AND**<br>potassium / sodium dichromate((VI)) or formulae | 1 |
| (c)(iii) | *In any order:* | |
| | but-1-ene | 1 |
| | but-2-ene | 1 |
| | *cis* / *Z*- AND *trans* / *E*- | 1 |
| (d)(i) |  | |
| | curly arrow from C=C to H | 1 |
| | correct dipole on HBr and curly arrow from bond of HBr to Br | 1 |
| | tertiary intermediate cation | 1 |
| | $Br^-$ with curly arrow from lone pair | 1 |
| (d)(ii) | (carbo)cation / tertiary ion / tertiary intermediate (more) stable (than primary) | 1 |
| | due to electron-releasing / (positive) inductive effect of more alkyl / methyl groups | 1 |

132. 9701_w15_ms_21 Q: 4

| | | |
|---|---|---|
| **(a) (i)** | $CH_3CH_2OH + HCl \rightarrow CH_3CH_2Cl + H_2O$<br>or<br>$CH_3CH_2OH + PCl_5 \rightarrow CH_3CH_2Cl + HCl + POCl_3$<br>or<br>$CH_3CH_2OH + SOCl_2 \rightarrow CH_3CH_2Cl + HCl + SO_2$ | [1+1] |
| **(ii)** | NaOH / KOH<br>warm / heat / reflux AND aqueous | [1]<br>[1] |
| **(b) (i)** | $CH_2{=}CH_2$ / ethane / $C_2H_4$ / $CH_2CH_2$ | [1] |
| **(ii)** | White ppt / solid / suspension | [1] |
| **(iii)** | $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ | [1] |
| **(c) (i)** | $CH_3CHO$ / ethanal | [1] |
| **(ii)** | $CH_3CH_2OH$ higher bpt than $CH_3CHO$ ora<br>due to hydrogen bonding in ethanol / stronger IMFs<br>prevents further oxidation owtte | [1]<br>[1]<br>[1] |
| | | |

133. 9701_s21_ms_23 Q: 4

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>(a)(i)</td><td>1,3-dichloropropan(-2-)one</td><td>1</td></tr>
<tr><td>(a)(ii)</td><td>carbonyl / ketone</td><td>1</td></tr>
<tr><td>(a)(iii)</td><td>$NaBH_4$ OR $LiAlH_4$</td><td>1</td></tr>
<tr><td>(b)</td><td>
<table>
<tr><td>reagent</td><td>observation with Q</td><td>observation with R</td></tr>
<tr><td>2,4-DNPH</td><td>M1 red / orange / yellow AND precipitate / solid / crystals</td><td>M2 red / orange / yellow AND precipitate / solid / crystals</td></tr>
<tr><td>$Na_2CO_3$(aq)</td><td>M3 no visible change</td><td>M4 fizz / effervescence</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>(c)</td><td>
<table>
<tr><td>step</td><td>reagent and conditions</td><td>type of rxn</td></tr>
<tr><td>1</td><td>M1 HCN and (trace) KCN / NaCN</td><td>M3 Addition</td></tr>
<tr><td>2</td><td>dilute sulfuric acid</td><td>Hydrolysis</td></tr>
<tr><td>3</td><td>M2 KCN/NaCN in ethanol / alcohol</td><td>M4 Substitution</td></tr>
<tr><td>4</td><td>dilute sulfuric acid</td><td>Hydrolysis</td></tr>
</table>
M5 type of reaction for step 2 AND step 4
</td><td>5</td></tr>
</table>

134. 9701_m21_ms_22 Q: 4

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>(a)</td><td>M1: $x$ = 108–110°<br>M2: $y$ = 118–122°</td><td>2</td></tr>
<tr><td>(b)</td><td>M1: red / orange / yellow ppt / solid<br>M2: silver mirror OR silver / grey / black / brown ppt / solid</td><td>2</td></tr>
<tr><td>(c)(i)</td><td>oxidising agent</td><td>1</td></tr>
<tr><td>(c)(ii)</td><td>M1: (excess dichromate and) heat under reflux<br>M2: to allow full oxidation (of alcohol and aldehyde groups)</td><td>2</td></tr>
<tr><td>(d)(i)</td><td>$CH_2OHCHO + 2[H] \rightarrow (CH_2OH)_2$</td><td>1</td></tr>
<tr><td>(d)(ii)</td><td>$NaBH_4$ / $LiAlH_4$</td><td>1</td></tr>
<tr><td>(d)(iii)</td><td>ethene</td><td>1</td></tr>
</table>