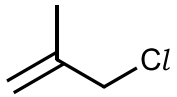
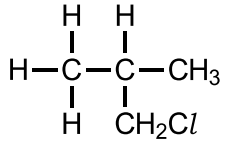
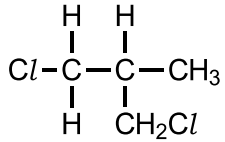
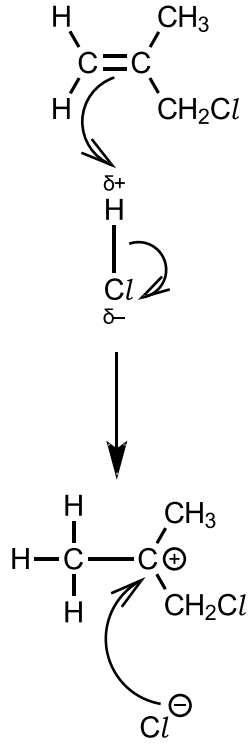
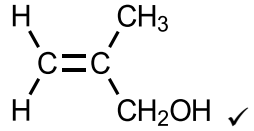
**Mark Scheme**

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | (a) | (i) | $C_4H_7Cl$ ✓ | 1 | |
| | | (ii) |  ✓ | 1 | **DO NOT ALLOW** non-skeletal formulae |
| | | (iii) | (compounds with) the same (molecular) formula<br><br>**AND** different structures / structural formulae / arrangement of atoms / displayed formulae ✓ | 1 | **ALLOW** same number of atoms of each element<br>**ALLOW** different carbon backbone<br>**DO NOT ALLOW** different spatial arrangement (of atoms) |
| | (b) | | $n = \frac{pV}{RT} = \frac{(100 \times 10^3) \times (1.053 \times 10^{-3})}{8.314 \times 350}$ ✓<br><br>$n$ = 0.0362 mol ✓<br><br>$M = \frac{m}{n} = \frac{1.321}{0.0362}$ = 36.5 (g mol$^{-1}$) ✓<br><br>*Identity*<br>$HCl$ ✓ | 4 | |
| | (c) | (i) | From **Reaction 1** =  ✓<br><br>compound **B** =  ✓ | 2 | **ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous |

**Mark Scheme**

| Question | | | Answer | Marks | Guidance |
|---|---|---|---|---|---|
| | | **(ii)** |  <br>Curly arrow from C=C to attack the H atom ✓<br>Correct dipole on H—C*l*<br>**AND** curly arrow from bond to C*l* ✓<br>Correct carbocation/carbonium ion with full positive charge shown<br>**AND** correct curly arrow from negative charge of C*l*$^-$ to correct carbon atom<br>**OR** correct curly arrow from lone pair of C*l*$^-$ to correct carbon atom ✓ | **3** | **ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous<br>Curly arrow must start from covalent bonds and not atoms<br>**DO NOT ALLOW** any other partial charges *e.g.* shown on double bond<br>**DO NOT ALLOW** C$^{\delta+}$ for charge on carbonium ion.<br>Curly arrow from C*l*$^-$ can start from the negative charge or the lone pair<br>**DO NOT ALLOW** delta negative, *i.e.* C*l*$^{\delta-}$ |
| | | **(iii)** | because the <u>intermediate/carbocation</u> in the formation of compound **B** is <u>less stable</u> (than the intermediate in the formation of compound **A**) ✓ | **1** | |
| | | **(iv)** |  ✓<br>(Formation of) <u>white</u> precipitate/solid/suspension<br>**AND** (ppt is) silver chloride/AgC*l* ✓ | **2** | **ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous |

**Mark Scheme**

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(d)</td><td></td><td>

***Use of elemental analysis data***

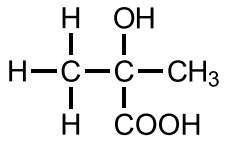
<table>
<tr><td></td><td>C</td><td>H</td><td>O</td></tr>
<tr><td>%</td><td>46.1</td><td>7.7</td><td>46.2</td></tr>
<tr><td>mol</td><td>3.84</td><td>7.7</td><td>2.89</td></tr>
<tr><td>ratio</td><td>1.33</td><td>2.66</td><td>1</td></tr>
</table>

atom ratio with calculation ✓<br>
empirical formula = $C_4H_8O_3$ ✓

***IR spectrum***<br>
(very) broad absorption 2500–3300 $cm^{-1}$ (CO**OH**)<br>
**AND** absorption 1640–1750 $cm^{-1}$ (C=O) ✓<br>
absorption 3450 $cm^{-1}$ (alcohol **–OH**) ✓

***Identification***

conclusion from data: compound contains –COOH and –OH (empirical formula confirms no other C=O than in COOH) in place of the previous chlorine-containing groups



✓

</td><td>**5**</td><td>

**ALLOW** any values given within ranges given on Data Sheet

**ALLOW** correct structural **OR** displayed **OR** skeletal formulae **OR** a combination of above as long as unambiguous

</td></tr>
<tr><td></td><td></td><td></td><td>**Total**</td><td>**20**</td><td></td></tr>
</table>

**Mark Scheme**

| Question | Answer | Marks | Guidance |
|---|---|---|---|
| 2 | B | 1 | |