This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.
1 (a) 

\[ \text{NH}_3 \quad \text{CH}_4 \]

- pyramidal
- tetrahedral

**both** ‘dot-and-cross’ diagrams correct (1)

\[ \text{NH}_3 \] is pyramidal or trigonal pyramidal (1)

\[ \text{CH}_4 \] is tetrahedral (1) [3]

(b) (i) nitrogen and hydrogen have different electronegativities (1)

N–H bond has a dipole or
\[ N^{\delta-} - \overline{H^{\delta+}} \] or
bonding pair is unequally shared (1)

(ii) molecule is not symmetrical or
dipoles do not cancel out (1)

(iii) \[ \text{NH}_3 \] has higher boiling point than expected from \( M_r \) value or
has higher boiling point than methane or
\[ \text{NH}_3 \] is soluble in water (1) [4]

(c) three covalent N–H bonds (1)

one co-ordinate (dative covalent) N–H bond (1)

one ionic bond between \[ \text{NH}_4^+ \] and \[ \text{Cl}^- \] (1) [3]

[Total: 10]
2 (a) (i) alkanes or paraffins not hydrocarbons (1)

(ii) \( \text{C}_9\text{H}_{20} + 14\text{O}_2 \rightarrow 9\text{CO}_2 + 10\text{H}_2\text{O} \) (1) [2]

(b) (i) carbon

(ii) CO is toxic or affects or combines with haemoglobin or carbon causes respiratory problems (1)

(iii) \( 2\text{C}_{14}\text{H}_{30} + 15\text{O}_2 \rightarrow 28\text{C} + 30\text{H}_2\text{O} \) or

\( 2\text{C}_{14}\text{H}_{30} + 29\text{O}_2 \rightarrow 28\text{CO} + 30\text{H}_2\text{O} \)

or other balanced equations such as

\( \text{C}_{14}\text{H}_{30} + 11\text{O}_2 \rightarrow 7\text{C} + 7\text{CO} + 15\text{H}_2\text{O} \)

\( \text{C}_{14}\text{H}_{30} + 18\text{O}_2 \rightarrow 7\text{CO} + 7\text{CO}_2 + 15\text{H}_2\text{O} \) (1) [4]

(c) enthalpy change when 1 mol of a substance is burnt in an excess of oxygen/air under standard conditions or is completely combusted under standard conditions (1) [2]

(d) working must be shown

(i) heat released = \( m \cdot c \cdot \Delta T \)

\( = 250 \times 4.18 \times 34.6 \)

\( = 36157 \text{ J} = 36.2 \text{ kJ} \) (1)

(ii) \( M_r \) of \( \text{C}_{14}\text{H}_{30} = 198 \)

mass of \( \text{C}_{14}\text{H}_{30} = 1.00 \times 0.763 = 0.763 \text{ g} \)

0.763 g of \( \text{C}_{14}\text{H}_{30} \) produce 36.2 kJ

198 g of \( \text{C}_{14}\text{H}_{30} \) produce \( \frac{36.2 \times 198}{0.763} \)

\( = 9394 \text{ kJ mol}^{-1} \) (1) [5]

[Total: 13]
3  (a)  (i)  

<table>
<thead>
<tr>
<th>halogen</th>
<th>melting point/°C</th>
<th>colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>chlorine</td>
<td>-101</td>
<td>green, yellow or greenish-yellow</td>
</tr>
<tr>
<td>bromine</td>
<td>-7</td>
<td>orange or red or brown</td>
</tr>
<tr>
<td>iodine</td>
<td>114</td>
<td>grey</td>
</tr>
</tbody>
</table>

chlorine and bromine both correct  (1)
iodine correct for solid  (1)

(ii) down the Group there are more electrons in the molecule hence stronger van der Waals’ forces  (1) [4]

(b)  (i)  

<table>
<thead>
<tr>
<th>chlorine</th>
<th>1s²2s²2p⁶3s²3p⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>bromine</td>
<td>1s²2s²2p⁶3s²3p⁶3d¹⁰4s²4p⁵</td>
</tr>
<tr>
<td>or</td>
<td>1s²2s²2p⁶3s²3p⁶4s²3d¹⁰4p⁵</td>
</tr>
</tbody>
</table>

both needed (1)

(ii)  

<table>
<thead>
<tr>
<th>Br</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>×</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

(1) [2]

(c)  (i) gas or low boiling liquid  (1)
BrCl has fewer electrons than Br₂ hence weaker van der Waals’ forces (1)

(ii) accept colours in the range yellow, orange, red, brown (1) [4]

(d)  (i) initially solution begins to turn yellow/brown after several minutes black/dark grey solid formed  (1)

(ii)  

\[ \text{Cl}_2 + 2\text{KI} \rightarrow 2\text{KCl} + \text{I}_2 \]  (1)

(iii)  

\[ \text{BrCl} + 2\text{KI} \rightarrow \text{KCl} + \text{KBr} + \text{I}_2 \]  (1)

(iv) as oxidising agents  (1) [5]

[Total: 15]
4 (a) (i) structural or functional group isomerism

(ii) R primary alcohol and carboxylic acid – not ‘acid’
S primary alcohol and ester
T primary alcohol and ester

(iii) with Na$_2$CO$_3$
    carboxylic acid

(iv) with Na
    alcohol and carboxylic acid

(b) (i) \[ n(\text{CO}_2) = \frac{24.0}{24000} = 0.001 \text{ mol} \] (1)

(ii) 0.002 mol of Q \(\rightarrow\) 0.001 mol of CO$_2$
    1 mol of Q \(\rightarrow\) 0.5 mol of CO$_2$

(c) (i) \[ n(\text{H}_2) = \frac{48.0}{24000} = 0.002 \text{ mol} \] (1)

(ii) 0.002 mol of Q \(\rightarrow\) 0.002 mol of H$_2$
    1 mol of Q \(\rightarrow\) 1 mol of H$_2$

(d) Q is isomer R

with sodium carbonate
\[ 2\text{HOCH}_2\text{CH}_2\text{CO}_2\text{H} + \text{Na}_2\text{CO}_3 \rightarrow 2 \text{HOCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}_2\text{O} + \text{CO}_2 \]
correct products
balanced (1)

with sodium metal
\[ \text{HOCH}_2\text{CH}_2\text{CO}_2\text{H} + 2\text{Na} \rightarrow \text{NaOCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}_2 \]
correct products
balanced (1) [5]

[Total: 15]
5  (a)  

\[ \text{O–H} \]

(1) [1]

(b)  

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>(\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H})</td>
</tr>
<tr>
<td>X</td>
<td>(\text{CH}_3\text{CH}_2\text{COCH}_3)</td>
</tr>
<tr>
<td>Y</td>
<td>((\text{CH}_3)_2\text{CHCO}_2\text{H})</td>
</tr>
<tr>
<td>Z</td>
<td>no reaction</td>
</tr>
</tbody>
</table>

(4 × 1) [4]

(c) alcohol is X (no mark for this)

products are

\[\text{CH}_3\text{CH}_2\text{CH}═\text{CH}_2\]

\[\begin{array}{c}
\text{CH}_3\text{C}═\text{CCH}_3 \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{CH}_3\text{C}═\text{CCH}_3 \\
\text{H}
\end{array}\]

(any two) [2]

[Total: 7]