MARK SCHEME for the May/June 2007 question paper

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
1 (a) (i) between 117° and 120°  

(ii) 

14 electrons must be shown
single N-N bond
lone pair on each N atom

(iii) between 107° and 109° 

(b) ethene – van der Waals’ forces
hydrazine – hydrogen bonds
hydrogen bonds are stronger or van der Waals’ forces are weaker 

(c) correct dipole on O—H and N—H bonds
labelled hydrogen bond shown
between an O atom of H₂O and a H atom of N₂H₄ or between an N atom of N₂H₄ and a H atom of H₂O
lone pair on O atom or on N atom in the H bond  
i.e.

or

(d) (i) CH₂ = CH₂ + HCl → CH₃CH₂Cl 

(ii) electrophilic addition 

(iii) there is no further unsaturation or CH₃CH₂Cl molecule is saturated or no possibility of addition or no free radicals are present 

(e) (i) acid – base/neutralization 

(ii) N atom has a lone pair of electrons or N atom can behave as a base or N atom can form dative bond 

(iii) each N atom has a lone pair or each nitrogen atom can behave as a base or each nitrogen atom can form a dative bond 

[Total: 16]
2 (a) rate of forward reaction equals rate of backward reaction
or equilibrium concentrations remain constant while reaction is occurring [1] [1]

(b) \( K_c = \frac{[CH_3CO_2C_2H_5][H_2O]}{[CH_3CO_2H][C_2H_5OH]} \) [1] [1]

(c) \( CH_3CO_2H + C_2H_5OH \rightarrow CH_3CO_2C_2H_5 + H_2O \)

\[
\begin{array}{c|cccc}
\text{initial moles} & 0.5 & 0.5 & 0.1 & 0.1 \\
\text{equil. moles} & (0.5 - x) & (0.5 - x) & (0.1 + x) & (0.1 + x) \\
\text{equil. concn./mol dm}^{-3} & \frac{(0.5 - x)}{V} & \frac{(0.5 - x)}{V} & \frac{(0.1 + x)}{V} & \frac{(0.1 + x)}{V} \\
\end{array}
\]

\[ K_c = \frac{(0.1 + x)^2}{(0.5 - x)^2} = 4 \] [1]

gives \( x = 0.3 \) [1]

\( n(CH_3CO_2H) = n(C_2H_5OH) = 0.2 \) and

\( n(CH_3CO_2C_2H_5) = n(H_2O) = 0.4 \) [1]

allow ecf on wrong equil. moles subject to \( x < 0.5 \) [4]

(d)

<table>
<thead>
<tr>
<th>alcohol</th>
<th>CH_3CH_2CH_2CH_2OH</th>
<th>CH_3CH_2CH(OH)CH_3</th>
<th>(CH_3)_3COH</th>
</tr>
</thead>
<tbody>
<tr>
<td>reagent(s) and conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>red phosphorus and iodine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>heat under reflux</td>
<td>X</td>
<td>CH_3CH_2CHCH_3</td>
<td>X</td>
</tr>
<tr>
<td>concentrated H_2SO_4</td>
<td>X</td>
<td>X</td>
<td>CH_3--C=CH_2</td>
</tr>
<tr>
<td>heat</td>
<td></td>
<td></td>
<td>CH_3</td>
</tr>
<tr>
<td>Cr_2O_7^{2-}/H^+</td>
<td></td>
<td></td>
<td>no reaction</td>
</tr>
<tr>
<td>heat under reflux</td>
<td>CH_3CH_2CH_2CO_2H</td>
<td>CH_3CH_2COCH_3</td>
<td></td>
</tr>
</tbody>
</table>

[Total: 11]
3 (a) 

<table>
<thead>
<tr>
<th></th>
<th>1s</th>
<th>2s</th>
<th>2p</th>
<th>3s</th>
<th>3p</th>
<th>3d</th>
<th>4s</th>
<th>4p</th>
<th>4d</th>
</tr>
</thead>
</table>
| Ca     | 2  | 2  | 6  | 2  | 6  | 0  | 2  | 0  | 0  | [1]
| Sr\(^{2+}\) | 2  | 2  | 6  | 2  | 6  | 10 | 2  | 6  |    | [1] [2]

(b) (i) more shells of electrons [1]
(ii) outermost shell has been removed [1]
(iii) outermost electrons are further from nucleus/there are more shells increased shielding [1] [4]

(c) (i) very slow reaction formation of bubbles of gas [1]
\[
\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2
\]
allow \( \text{Mg} + 2\text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2 + \text{H}_2 \) [1]
(ii) faster reaction than with Mg [1]
white suspension formed or evolution of gas or calcium dissolves/disappears [1]
\[
\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2
\]
allow 1 mark in (i) or (ii) if gas is described as colourless [1] [7]

(d) (i) gas evolved gas is brown [1]
(ii) \( 2\text{Sr(NO}_3)_2 \rightarrow 2\text{SrO} + 4\text{NO}_2 + \text{O}_2 \) correct products balanced equation [1] [4]

[Total: 17 max. 16]
4 (a) (i) white ppt.  
   AgCl  
   [1]  

(ii) white/steamy/misty fumes  
   HCl  
   [1]  

(iii) colourless gas evolved or Na dissolves  
   H₂ or CH₃ONa  
   [1] [6]  

(b) \[ \frac{40}{2} : \frac{6.7}{1} : \frac{53.3}{16} = 3.33 : 6.7 : 3.33 = 1 : 2 : 1 \]  
   [1] [2]  

(c)  
   [image of structures]  
   [1] [1] [3]  

(d) (i) with solid NaHCO₃  
   candidate’s carboxylic acid [X above]  
   gas/CO₂ evolved  
   [1] [1]  

(ii) with Tollens’ reagent  
   candidate’s aldehyde [Z above]  
   Ag mirror/Ag ppt.  
   [1] [4]  

(e) two correct structures [of Y above]  
   correctly labelled cis and trans  
   [1] [1] [2]  

[Total: 17]