Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**CHEMISTRY** **9701/34**

Paper 3 Advanced Practical Skills 2 **May/June 2019**

MARK SCHEME

Maximum Mark: 40

**Published**

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

**PUBLISHED**

## Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen). |
| GENERIC MARKING PRINCIPLE 6:<br><br>Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind. |

| Question | Answer | Marks |
|---|---|---|
| 1(a) | **I** The following data must be shown<br>• burette readings **and** titre for rough titration<br>• 2 × 2 'box' showing both accurate burette readings | **1** |
| | **II** Headings and units correct for accurate titration table and headings match readings.<br>• initial / start (burette) reading / volume + unit<br>• final / end (burette) reading / volume + unit<br>• titre ***or*** volume / **FB 1 and** used / added + unit<br>Units: ($cm^3$) or / $cm^3$ or in $cm^3$ or $cm^3$ by every entry | **1** |
| | **III** All accurate burette readings to 0.05 $cm^3$ | **1** |
| | **IV** The **final** accurate titre recorded is within 0.10 $cm^3$ of any other accurate titre | **1** |
| | Award **V** if $0.30 < \delta \leqslant 0.50\ cm^3$ | **1** |
| | Award **VI** if $0.20 < \delta \leqslant 0.30\ cm^3$ | **1** |
| | Award **VII** if $\delta \leqslant 0.20\ cm^3$ | **1** |
| 1(b) | Candidate must average two (or more) titres that are **all** within 0.20 $cm^3$.<br>Working must be shown **or** ticks must be put next to the two (or more) accurate titres selected. | **1** |
| 1(c)(i) | **All** final answers to **(ii)**–**(v)** to 3 or 4 sf<br>Minimum 3 answers displayed | **1** |
| 1(c)(ii) | Correctly calculates $\frac{0.02 \times \textbf{(b)}}{1000}$ | **1** |
| 1(c)(iii) | Correct use of **(ii)** × 5 | **1** |
| 1(c)(iv) | Correct use of **(iii)** × 55.8 | **1** |
| 1(c)(v) | Correctly uses $\frac{\textbf{(c)(iv)} \times 40 \times 100}{6.02}$ **or** $\frac{\textbf{(c)(iv)} \times 100}{0.1505}$ | **1** |

| Question | Answer | Marks |
|---|---|---|
| 1(d) | Student incorrect<br>sodium hydroxide will also react with **$Fe^{2+}$** / iron(II) / iron(II) sulfate<br>**OR**<br>Impurity (in wire) reacts with sulfuric acid / sodium hydroxide | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | **I** All 9 specified volumes recorded to nearest 0.05 $cm^3$ and all temperatures to .0 or .5 °C. | **1** |
| | **II** Award this mark based on the tolerance table | **1** |
| | **III** Award this mark based on the tolerance table | **1** |
| | <table><tr><td>Sup $\Delta T_{max}$</td><td>$\geqslant$ 10.5 °C</td><td>6.5–10.0 °C</td><td>3.5–6.0 °C</td><td>$\leqslant$ 3.0 °C</td></tr><tr><td>1 mark</td><td>$\delta$ = 2.0 °C</td><td>$\delta$ = 1.5 °C</td><td>$\delta$ = 1.0 °C</td><td>$\delta$ = 0.5 °C</td></tr><tr><td>2 marks</td><td>$\delta$ = 1.0 °C</td><td>$\delta$ = 1.0 °C</td><td>$\delta$ = 0.5 °C</td><td>not available</td></tr></table> | |
| 2(b) | **I** Linear scales chosen so that graph occupies more than half the available length for both axes (including extra 2 °C for *y*-axis). (6 big squares on *y*-axis & 5 on *x*-axis)<br>**and** axes labelled with name or unit | **1** |
| | **II** **All** points recorded accurately plotted (*within ½ small square and in the correct square of linear scale within plotting area*). | **1** |
| | **III** Two best fit straight lines / curves drawn so they intersect / meet – one for increasing temperature and one for decreasing temperature (or no change in temperature).<br><br>*Reject an intersection below the highest temperature recorded unless that point has been labelled as anomalous.* | **1** |
| | **IV** Correct volume from suitable intersect to 1 or 2 dp<br><br>*A continuous curve cannot score either mark **III** or **IV***<br>*Neither **III** nor **IV** can be scored if there is no max T* | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(c)(i) | Correctly calculates $\frac{0.90 \times V\textbf{(b)}}{1000}$ to minimum 2 sf | **1** |
| 2(c)(ii) | Correct expression: **(c)(i)** / 2<br>**and**<br>answer × 1000 / 10 | **1** |
| 2(d) | Explain how to get m **or** $\Delta$T using words or figures<br><br>m = 10 / volume of acid used **+** volume of NaOH / **FB 4** at intersect / at highest temperature / from maximum on graph / needed to neutralise the acid<br>$\Delta$T = T at intersect – initial $T_{acid\ /\ \textbf{FB 3}}$ (or mean initial $T_{acid + base}$) / $T_{max}$ – initial $T_{(acid\ /\ \textbf{FB 3})}$ from table<br><br>*Allow quoted correct figures from the table ($\Delta T$) or the graph ($\Delta T$ or m)* | **1** |
| | Use of mc$\Delta$T | **1** |
| | **Divide** heat energy produced / moles of acid / 1st part of **(c)(ii)** | **1** |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FB 5 = $(CO_2)_2Na_2$; FB 6 = $CaCl_2$; FB 7 = $FeSO_4$</td></tr>
<tr><td>3(a)</td><td>Award one mark for every two correct observations (*)<br>On warming with $KMnO_4$ any test that positively identifies a gas is CON for that test apart from with FB 5 ($CO_2$).</td><td>7</td></tr>
<tr><td>3(a)</td><td>
<table>
<tr><th rowspan="2">test</th><th colspan="3">observations</th></tr>
<tr><th>FB 5</th><th>FB 6</th><th>FB 7</th></tr>
<tr><td>+ $H^+$ / $MnO_4^-$</td><td>no change / no (visible) reaction / stays / turns pink *</td><td>no change / no (visible) reaction / stays / turns pink / purple and</td><td>(purple) turns colourless / decolourises / turns yellow *</td></tr>
<tr><td>warm</td><td>Decolourises *</td><td>no change / stays purple *</td><td>ignore</td></tr>
<tr><td>+ $HNO_3$</td><td>no change / no (visible) reaction *</td><td>no change / no (visible) reaction *</td><td>no change / no (visible) reaction and</td></tr>
<tr><td>then $Ag^+$</td><td>white ppt *</td><td>white ppt *</td><td>no change / no visible reaction / no ppt *</td></tr>
<tr><td>+ $HCl$</td><td></td><td>no change / no (visible) reaction / no ppt and</td><td>no change / no (visible) reaction / no ppt *</td></tr>
<tr><td>then $Ba^{2+}$</td><td></td><td>no change / no (visible) reaction / no ppt *</td><td>white ppt *</td></tr>
<tr><td>+ FB 5</td><td></td><td>white ppt *</td><td>(solution) turns yellow *</td></tr>
</table>
</td><td></td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>Selects NaOH and $NH_3$ (allow $NH_4OH$)<br>Ignore a named sulfate (including sulfuric acid)</td><td>1</td></tr>
<tr><td></td><td>
<table>
<tr><th></th><th>FB 6</th><th>FB 7</th></tr>
<tr><td>+ NaOH</td><td>white ppt<br>and insoluble in excess *</td><td>green ppt<br>and insoluble in excess *</td></tr>
<tr><td>+ $NH_3$</td><td>no (visible) reaction / no change / no ppt *</td><td>green ppt and insoluble in excess *</td></tr>
</table>
For two correct observations (*) award one mark<br><br>Mark vertically or horizontally.</td><td>2</td></tr>
<tr><td></td><td>FB 7 (ppt) turns brown on standing / in air with either alkali<br>OR<br>No (white) ppt / no reaction stated for FB 6 with the named sulfate.</td><td>1</td></tr>
<tr><td>3(b)(ii)</td><td>
<table>
<tr><th></th><th>FB 6</th><th>FB 7</th></tr>
<tr><td>cation</td><td>$Ca^{2+}$ / $Ba^{2+}$ *<br>allow both<br>allow unknown if no sulfate test carried out</td><td>$Fe^{2+}$ *</td></tr>
<tr><td>anion</td><td>$Cl^-$</td><td>$SO_4^{2-}$ *</td></tr>
</table>
For two correct observations (*) award one mark<br>Allow 1 mark if all correct names given (iron(II)) instead of formulae.</td><td>2</td></tr>
</table>

| Question | Answer | Marks |
|---|---|---|
| 3(b)(iii) | Precipitation reaction for **FB 7**:<br><br>$Fe^{2+}(aq) + 2OH^{-}(aq) \rightarrow Fe(OH)_2(s)$<br>**or**<br>$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ | **1** |