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**CHEMISTRY**

**9701/34**

Paper 3 Advanced Practical Skills 2

**May/June 2019**

MARK SCHEME

Maximum Mark: 40

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**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.

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This document consists of **10** printed pages.

**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.

**GENERIC MARKING PRINCIPLE 5:**

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:**

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.

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Question	Answer	Marks
1(a)	<b>I</b> The following data must be shown <ul style="list-style-type: none"> <li>• burette readings <b>and</b> titre for rough titration</li> <li>• 2 × 2 ‘box’ showing both accurate burette readings</li> </ul>	<b>1</b>
	<b>II</b> Headings and units correct for accurate titration table and headings match readings. <ul style="list-style-type: none"> <li>• initial / start (burette) reading / volume + unit</li> <li>• final / end (burette) reading / volume + unit</li> <li>• titre <b>or</b> volume / <b>FB 1 and</b> used / added + unit</li> </ul> Units: (cm <sup>3</sup> ) or / cm <sup>3</sup> or in cm <sup>3</sup> or cm <sup>3</sup> by every entry	<b>1</b>
	<b>III</b> All accurate burette readings to 0.05 cm <sup>3</sup>	<b>1</b>
	<b>IV</b> The <b>final</b> accurate titre recorded is within 0.10 cm <sup>3</sup> of any other accurate titre	<b>1</b>
	Award <b>V</b> if $0.30 < \delta \leq 0.50 \text{ cm}^3$	<b>1</b>
	Award <b>VI</b> if $0.20 < \delta \leq 0.30 \text{ cm}^3$	<b>1</b>
	Award <b>VII</b> if $\delta \leq 0.20 \text{ cm}^3$	<b>1</b>
1(b)	Candidate must average two (or more) titres that are <b>all</b> within 0.20 cm <sup>3</sup> . Working must be shown <b>or</b> ticks must be put next to the two (or more) accurate titres selected.	<b>1</b>
1(c)(i)	<b>All</b> final answers to <b>(ii)–(v)</b> to 3 or 4 sf Minimum 3 answers displayed	<b>1</b>
1(c)(ii)	Correctly calculates $\frac{0.02 \times \mathbf{(b)}}{1000}$	<b>1</b>
1(c)(iii)	Correct use of <b>(ii)</b> × 5	<b>1</b>
1(c)(iv)	Correct use of <b>(iii)</b> × 55.8	<b>1</b>
1(c)(v)	Correctly uses $\frac{\mathbf{(c)(iv)} \times 40 \times 100}{6.02}$ <b>or</b> $\frac{\mathbf{(c)(iv)} \times 100}{0.1505}$	<b>1</b>

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

Question	Answer	Marks					
2(a)	<b>I</b> All 9 specified volumes recorded to nearest 0.05 cm <sup>3</sup> and all temperatures to .0 or .5 °C.	<b>1</b>					
	<b>II</b> Award this mark based on the tolerance table	<b>1</b>					
	<b>III</b> Award this mark based on the tolerance table	<b>1</b>					
	<table border="1" data-bbox="353 411 1581 478"> <tr> <td>Sup <math>\Delta T_{\max}</math></td> <td><math>\geq 10.5\text{ }^{\circ}\text{C}</math></td> <td>6.5–10.0 °C</td> <td>3.5–6.0 °C</td> <td><math>\leq 3.0\text{ }^{\circ}\text{C}</math></td> </tr> </table>	Sup $\Delta T_{\max}$	$\geq 10.5\text{ }^{\circ}\text{C}$	6.5–10.0 °C	3.5–6.0 °C	$\leq 3.0\text{ }^{\circ}\text{C}$	
	Sup $\Delta T_{\max}$	$\geq 10.5\text{ }^{\circ}\text{C}$	6.5–10.0 °C	3.5–6.0 °C	$\leq 3.0\text{ }^{\circ}\text{C}$		
<table border="1" data-bbox="353 481 1581 545"> <tr> <td>1 mark</td> <td><math>\delta = 2.0\text{ }^{\circ}\text{C}</math></td> <td><math>\delta = 1.5\text{ }^{\circ}\text{C}</math></td> <td><math>\delta = 1.0\text{ }^{\circ}\text{C}</math></td> <td><math>\delta = 0.5\text{ }^{\circ}\text{C}</math></td> </tr> </table>	1 mark	$\delta = 2.0\text{ }^{\circ}\text{C}$	$\delta = 1.5\text{ }^{\circ}\text{C}$	$\delta = 1.0\text{ }^{\circ}\text{C}$	$\delta = 0.5\text{ }^{\circ}\text{C}$		
1 mark	$\delta = 2.0\text{ }^{\circ}\text{C}$	$\delta = 1.5\text{ }^{\circ}\text{C}$	$\delta = 1.0\text{ }^{\circ}\text{C}$	$\delta = 0.5\text{ }^{\circ}\text{C}$			
<table border="1" data-bbox="353 549 1581 612"> <tr> <td>2 marks</td> <td><math>\delta = 1.0\text{ }^{\circ}\text{C}</math></td> <td><math>\delta = 1.0\text{ }^{\circ}\text{C}</math></td> <td><math>\delta = 0.5\text{ }^{\circ}\text{C}</math></td> <td>not available</td> </tr> </table>	2 marks	$\delta = 1.0\text{ }^{\circ}\text{C}$	$\delta = 1.0\text{ }^{\circ}\text{C}$	$\delta = 0.5\text{ }^{\circ}\text{C}$	not available		
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2(b)	<b>I</b> 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) <b>and</b> axes labelled with name or unit	<b>1</b>					
	<b>II</b> All points recorded accurately plotted ( <i>within ½ small square and in the correct square of linear scale within plotting area</i> ).	<b>1</b>					
	<b>III</b> 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).  <i>Reject an intersection below the highest temperature recorded unless that point has been labelled as anomalous.</i>	<b>1</b>					
	<b>IV</b> Correct volume from suitable intersect to 1 or 2 dp  <i>A continuous curve cannot score either mark III or IV Neither III nor IV can be scored if there is no max T</i>	<b>1</b>					

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

Question	Answer			Marks																																			
<b>FB 5 = (CO<sub>2</sub>)<sub>2</sub>Na<sub>2</sub>; FB 6 = CaCl<sub>2</sub>; FB 7 = FeSO<sub>4</sub></b>																																							
3(a)	Award one mark for every two correct observations (*) On warming with KMnO <sub>4</sub> any test that positively identifies a gas is CON for that test apart from with <b>FB 5</b> (CO <sub>2</sub> ).			<b>7</b>																																			
3(a)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="349 376 600 512" rowspan="2"><i>test</i></th> <th colspan="3" data-bbox="604 376 1924 443"><i>observations</i></th> </tr> <tr> <th data-bbox="604 446 1012 512" style="text-align: center;"><b>FB 5</b></th> <th data-bbox="1016 446 1476 512" style="text-align: center;"><b>FB 6</b></th> <th data-bbox="1480 446 1924 512" style="text-align: center;"><b>FB 7</b></th> </tr> </thead> <tbody> <tr> <td data-bbox="349 515 600 644">+ H<sup>+</sup> / MnO<sub>4</sub><sup>-</sup></td> <td data-bbox="604 515 1012 644">no change / no (visible) reaction / stays / turns pink *</td> <td data-bbox="1016 515 1476 644" style="background-color: #e6e6fa;">no change / no (visible) reaction / stays / turns pink / purple <b>and</b></td> <td data-bbox="1480 515 1924 644">(purple) turns colourless / decolourises / turns yellow *</td> </tr> <tr> <td data-bbox="349 647 600 713">warm</td> <td data-bbox="604 647 1012 713">Decolourises *</td> <td data-bbox="1016 647 1476 713" style="background-color: #e6e6fa;">no change / stays purple *</td> <td data-bbox="1480 647 1924 713"><i>ignore</i></td> </tr> <tr> <td data-bbox="349 716 600 813">+ HNO<sub>3</sub></td> <td data-bbox="604 716 1012 813">no change / no (visible) reaction *</td> <td data-bbox="1016 716 1476 813">no change / no (visible) reaction *</td> <td data-bbox="1480 716 1924 813" style="background-color: #ffe4c4;">no change / no (visible) reaction <b>and</b></td> </tr> <tr> <td data-bbox="349 817 600 914">then Ag<sup>+</sup></td> <td data-bbox="604 817 1012 914">white ppt *</td> <td data-bbox="1016 817 1476 914">white ppt *</td> <td data-bbox="1480 817 1924 914" style="background-color: #ffe4c4;">no change / no visible reaction / no ppt *</td> </tr> <tr> <td data-bbox="349 917 600 1046">+ HCl</td> <td data-bbox="604 917 1012 1046" style="background-color: #d3d3d3;"></td> <td data-bbox="1016 917 1476 1046" style="background-color: #add8e6;">no change / no (visible) reaction / no ppt <b>and</b></td> <td data-bbox="1480 917 1924 1046">no change / no (visible) reaction / no ppt *</td> </tr> <tr> <td data-bbox="349 1050 600 1147">then Ba<sup>2+</sup></td> <td data-bbox="604 1050 1012 1147" style="background-color: #d3d3d3;"></td> <td data-bbox="1016 1050 1476 1147" style="background-color: #add8e6;">no change / no (visible) reaction / no ppt *</td> <td data-bbox="1480 1050 1924 1147">white ppt *</td> </tr> <tr> <td data-bbox="349 1150 600 1217">+ <b>FB 5</b></td> <td data-bbox="604 1150 1012 1217" style="background-color: #d3d3d3;"></td> <td data-bbox="1016 1150 1476 1217">white ppt *</td> <td data-bbox="1480 1150 1924 1217">(solution) turns yellow *</td> </tr> </tbody> </table>			<i>test</i>	<i>observations</i>			<b>FB 5</b>	<b>FB 6</b>	<b>FB 7</b>	+ H <sup>+</sup> / MnO <sub>4</sub> <sup>-</sup>	no change / no (visible) reaction / stays / turns pink *	no change / no (visible) reaction / stays / turns pink / purple <b>and</b>	(purple) turns colourless / decolourises / turns yellow *	warm	Decolourises *	no change / stays purple *	<i>ignore</i>	+ HNO <sub>3</sub>	no change / no (visible) reaction *	no change / no (visible) reaction *	no change / no (visible) reaction <b>and</b>	then Ag <sup>+</sup>	white ppt *	white ppt *	no change / no visible reaction / no ppt *	+ HCl		no change / no (visible) reaction / no ppt <b>and</b>	no change / no (visible) reaction / no ppt *	then Ba <sup>2+</sup>		no change / no (visible) reaction / no ppt *	white ppt *	+ <b>FB 5</b>		white ppt *	(solution) turns yellow *	
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Question	Answer		Marks									
3(b)(i)	Selects NaOH and NH <sub>3</sub> ( <i>allow NH<sub>4</sub>OH</i> ) <i>Ignore a named sulfate (including sulfuric acid)</i>		1									
	<table border="1" data-bbox="349 312 1086 647"> <thead> <tr> <th></th> <th>FB 6</th> <th>FB 7</th> </tr> </thead> <tbody> <tr> <td>+ NaOH</td> <td>white ppt <b>and</b> insoluble in excess *</td> <td>green ppt <b>and</b> insoluble in excess *</td> </tr> <tr> <td>+ NH<sub>3</sub></td> <td>no (visible) reaction / no change / no ppt *</td> <td>green ppt <b>and</b> insoluble in excess *</td> </tr> </tbody> </table> <p data-bbox="349 651 981 683">For two correct observations (*) award one mark</p> <p data-bbox="349 718 734 750"><i>Mark vertically or horizontally.</i></p>			FB 6	FB 7	+ NaOH	white ppt <b>and</b> insoluble in excess *	green ppt <b>and</b> insoluble in excess *	+ NH <sub>3</sub>	no (visible) reaction / no change / no ppt *	green ppt <b>and</b> insoluble in excess *	2
	FB 6	FB 7										
+ NaOH	white ppt <b>and</b> insoluble in excess *	green ppt <b>and</b> insoluble in excess *										
+ NH <sub>3</sub>	no (visible) reaction / no change / no ppt *	green ppt <b>and</b> insoluble in excess *										
	<p data-bbox="349 783 1104 815"><b>FB 7</b> (ppt) turns brown on standing / in air with either alkali</p> <p data-bbox="349 818 398 850"><b>OR</b></p> <p data-bbox="349 853 1209 885">No (white) ppt / no reaction stated for <b>FB 6</b> with the named sulfate.</p>		1									
3(b)(ii)	<table border="1" data-bbox="349 914 1086 1249"> <thead> <tr> <th></th> <th>FB 6</th> <th>FB 7</th> </tr> </thead> <tbody> <tr> <td>cation</td> <td>Ca<sup>2+</sup> / Ba<sup>2+</sup> * <i>allow both</i> <i>allow unknown if</i> <i>no sulfate test</i> <i>carried out</i></td> <td>Fe<sup>2+</sup> *</td> </tr> <tr> <td>anion</td> <td>Cl<sup>-</sup></td> <td>SO<sub>4</sub><sup>2-</sup> *</td> </tr> </tbody> </table> <p data-bbox="349 1284 1232 1348">For two correct observations (*) award one mark <i>Allow 1 mark if all correct names given (iron(II)) instead of formulae.</i></p>			FB 6	FB 7	cation	Ca <sup>2+</sup> / Ba <sup>2+</sup> * <i>allow both</i> <i>allow unknown if</i> <i>no sulfate test</i> <i>carried out</i>	Fe <sup>2+</sup> *	anion	Cl <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup> *	2
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Question	Answer	Marks
3(b)(iii)	Precipitation reaction for <b>FB 7</b> : $\text{Fe}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$ <b>or</b> $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$	<b>1</b>