Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2019**

MARK SCHEME

Maximum Mark: 30

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 October/November 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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: 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)(i)	**M1:** moles of Y_2O_3 = 0.750 ÷ (2 × 88.9 + 3 × 16.0) = 0.750 ÷ 225.8 = 3.32×10^{-3} (mol) 3.3215235×10^{-3} **M2:** mass of $BaCO_3$ = $4 \times 3.32 \times 10^{-3} \times (137.3 + 12.0 + 3 \times 16.0)$ = $4 \times 3.32 \times 10^{-3} \times 197.3$ = 2.62 (g) 2.6213463 **M3:** mass of CuO = $6 \times 3.32 \times 10^{-3} \times (63.5 + 16.0)$ = $6 \times 3.32 \times 10^{-3} \times 79.5$ = 1.58 (g) 1.5813667	**3**
1(a)(ii)	**heat** solid again (and allow to cool) **AND** (to) constant mass	**1**
1(b)(i)	(Prevents) reaction of Cu^{2+} with I^- **OR** (prevents) formation of CuI / Cu^+ / copper(I) **OR** (prevents) oxidation of I^- (to I_2) by Cu^{2+}	**1**
1(b)(ii)	I^- is oxidised (to I_2) in acidic solution	**1**
1(b)(iii)	2A	**1**
1(c)(i)	$1.0 \times 250.0 / 1000 \times 294.0 = 73.5$ (g)	**1**
1(c)(ii)	**M1:** Dissolve / make a solution in (beaker) in (small volume of distilled water) **M2: Add / transfer solution** to a 250 cm^3 volumetric flask **M3:** Make to mark of (volumetric) flask with distilled water and the washings	**3**
1(d)	**M1:** titres are not concordant **M2:** repeat titration **until concordant titres are obtained** OR improved valid experimental technique	**2**

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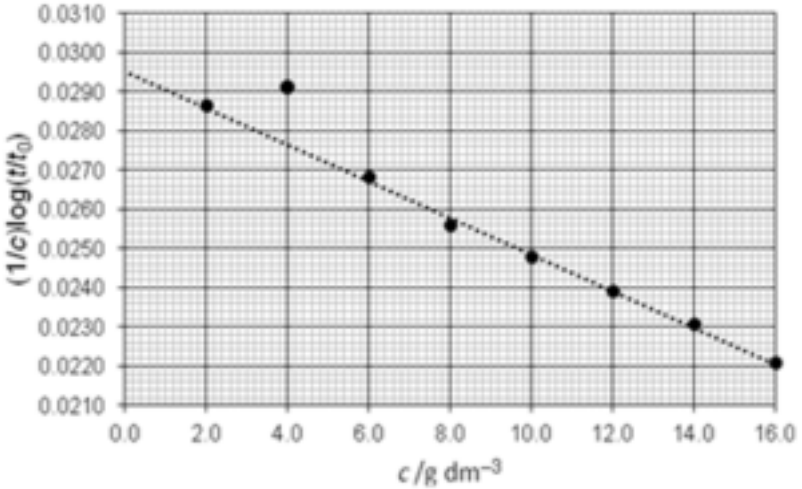
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>M1: to remove (remaining) hydrochloric and nitric acid

M2: to remove water / dry the tube</td><td>2</td></tr>
<tr><td>2(b)</td><td>
<table>
<tr><th>c</th><th>$\frac{1}{c}$</th><th>t</th><th>$\frac{t}{t_0}$</th><th>$\log\frac{t}{t_0}$</th><th>$\frac{1}{c}\log\frac{t}{t_0}$</th></tr>
<tr><td>16.0</td><td>0.0625</td><td>176</td><td>2.26</td><td>0.354</td><td>0.0221</td></tr>
<tr><td>14.0</td><td>0.0714</td><td>164</td><td>2.10</td><td>0.322</td><td>0.0230</td></tr>
<tr><td>12.0</td><td>0.0833</td><td>151</td><td>1.94</td><td>0.288</td><td>0.0240</td></tr>
<tr><td>10.0</td><td>0.100</td><td>138</td><td>1.77</td><td>0.248</td><td>0.0248</td></tr>
<tr><td>8.0</td><td>0.125</td><td>125</td><td>1.60</td><td>0.204</td><td>0.0255</td></tr>
<tr><td>6.0</td><td>0.167</td><td>113</td><td>1.45</td><td>0.161</td><td>0.0269
0.0268</td></tr>
<tr><td>4.0</td><td>0.250</td><td>102</td><td>1.31</td><td>0.117</td><td>0.0293</td></tr>
<tr><td>2.0</td><td>0.500</td><td>89</td><td>1.14</td><td>0.0569</td><td>0.0285</td></tr>
</table>
M1: for column 2, $\frac{1}{c}$, to 3 SF

M2: for column 5, $\log\frac{t}{t_0}$, to 3 SF

M3: for column 6, $\frac{1}{c}\log\frac{t}{t_0}$, to 3 SF
</td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(c)	 **M1:** all eight points plotted correctly **M2:** best-fit **straight** line drawn	**2**
2(d)(i)	**M1:** time will be greater / longer / flows more slowly (at a lower temperature) **M2:** solution is more viscous	**1** **1**
2(d)(ii)	use a **controlled** water bath (at 25 °C)	**1**
2(e)	point at (4.0, 0.0286) circled **AND** timer / (initial) time started too early / timer (final) time stopped too late	**1**
2(f)(i)	correctly extrapolates best-fit line to vertical intercept **AND** η = intercept $\times$ 2.30	**1**
2(f)(ii)	**M1:** log M_r = 1.59 log η + 7.03 **M2:** $M_r = 1.48 \times 10^5$	**2**
2(f)(iii)	$M_r \div 104.0$ x = 1422	**1**

Question	Answer	Marks
2(g)	**M1:** *a* will be higher **M2:** poly(ethenol) and water form stronger / greater intermolecular forces (than between poly(phenylethene) with methyl benzene) **OR** poly(ethenol) and water form strong(er) hydrogen bonds (which were not present before)	**2**

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