
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.

This document consists of **7** printed pages.

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.

PUBLISHED**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).

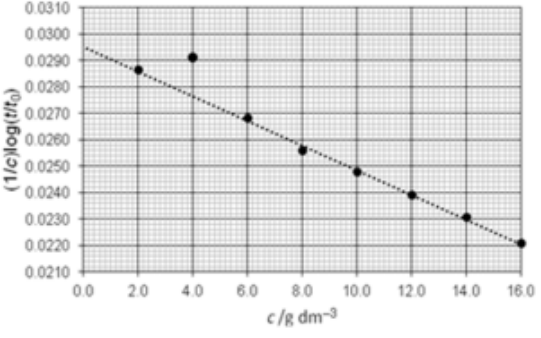
GENERIC MARKING PRINCIPLE 6:

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.

PUBLISHED

Question	Answer	Marks
1(a)(i)	<p>M1: moles of Y_2O_3 = $0.750 \div (2 \times 88.9 + 3 \times 16.0)$ = $0.750 \div 225.8$ = 3.32×10^{-3} (mol) 3.3215235×10^{-3}</p> <p>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</p> <p>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</p>	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)	<p>M1: Dissolve / make a solution in (beaker) in (small volume of distilled water)</p> <p>M2: Add / transfer solution to a <u>250 cm³ volumetric flask</u></p> <p>M3: Make to mark of (volumetric) flask with distilled water and the washings</p>	3
1(d)	<p>M1: titres are not concordant</p> <p>M2: repeat titration until concordant titres are obtained OR improved valid experimental technique</p>	2

Question	Answer					Marks																																																						
2(a)	M1: to remove (remaining) hydrochloric and nitric acid M2: to remove water / dry the tube					2																																																						
2(b)	<table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>M1: for column 2, $\frac{1}{c}$, to 3 SF</p> <p>M2: for column 5, $\log \frac{t}{t_0}$, to 3 SF</p> <p>M3: for column 6, $\frac{1}{c} \log \frac{t}{t_0}$, to 3 SF</p>					c	$\frac{1}{c}$	t	$\frac{t}{t_0}$	$\log \frac{t}{t_0}$	$\frac{1}{c} \log \frac{t}{t_0}$	16.0	0.0625	176	2.26	0.354	0.0221	14.0	0.0714	164	2.10	0.322	0.0230	12.0	0.0833	151	1.94	0.288	0.0240	10.0	0.100	138	1.77	0.248	0.0248	8.0	0.125	125	1.60	0.204	0.0255	6.0	0.167	113	1.45	0.161	0.0269 0.0268	4.0	0.250	102	1.31	0.117	0.0293	2.0	0.500	89	1.14	0.0569	0.0285	3
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Question	Answer	Marks
2(c)	 <p data-bbox="231 492 542 571">M1: all eight points plotted correctly M2: best-fit straight line drawn</p>	2
2(d)(i)	<p data-bbox="231 582 893 616">M1: time will be greater / longer / flows more slowly (at a lower temperature)</p> <p data-bbox="231 622 478 656">M2: solution is more viscous</p>	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 $\eta = \text{intercept} \times 2.30$	1
2(f)(ii)	<p data-bbox="231 801 494 835">M1: $\log M_r = 1.59 \log \eta + 7.03$</p> <p data-bbox="231 842 399 875">M2: $M_r = 1.48 \times 10^5$</p>	2
2(f)(iii)	<p data-bbox="231 891 319 925">$M_r \div 104.0$</p> <p data-bbox="231 931 303 943">$x = 1422$</p>	1

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