
CHEMISTRY**9701/52**

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.

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.

PUBLISHED

Question	Answer	Marks
1(a)(i)	arrow pointing inwards at bottom condenser inlet	1
1(a)(ii)	Solution A / alkali must be added dropwise	1
1(a)(iii)	to prevent vapour loss / escape of vapour	1
1(a)(iv)	(incorrect) heating causes gases to expand OR Pressure would build up (causing apparatus to pop apart)	1
1(b)(i)	M1: Condenser sloping in the 'distillation' position able to accept distillate vapours M2: Condenser with (delivery) end open and rest of apparatus sealed	2
1(b)(ii)	CH ₃ CH ₂ OH AND lowest boiling point.	1
1(b)(iii)	M1: Cool (the solution) (until crystals form) M2: Filter AND rinse (the crystals) [with (cold) water].	2
1(c)	M1: mass obtained would be less M2: because of H ₂ O loss / formation / production	2
1(d)	M1: (only) CH ₃ I is a liquid at room temperature M2: (C—I) bond weakest / easiest to break	2

PUBLISHED

Question	Answer									Marks																																																																																										
2(a)(i)	mass = $0.100 \times (10 \times 12.0 + 8 \times 1.0) = 12.8(0)$									1																																																																																										
2(a)(ii)	<table border="1" data-bbox="342 284 1854 938"> <thead> <tr> <th data-bbox="342 284 539 347">Mol</th> <th colspan="3" data-bbox="539 284 1032 347">Y</th> <th data-bbox="1032 284 1182 347">temp</th> <th data-bbox="1182 284 1323 347">$1/T_m$</th> <th colspan="3" data-bbox="1323 284 1854 347">Log Y</th> </tr> </thead> <tbody> <tr> <td data-bbox="342 347 539 411">0.00</td> <td data-bbox="539 347 734 411">1.00...</td> <td data-bbox="734 347 909 411">1.00</td> <td data-bbox="909 347 1032 411">1.00</td> <td data-bbox="1032 347 1182 411">353</td> <td data-bbox="1182 347 1323 411">2.83</td> <td data-bbox="1323 347 1496 411">0.00</td> <td data-bbox="1496 347 1671 411">0.00</td> <td data-bbox="1671 347 1854 411">0.00</td> </tr> <tr> <td data-bbox="342 411 539 475">0.00888</td> <td data-bbox="539 411 734 475">0.91844...</td> <td data-bbox="734 411 909 475">0.918</td> <td data-bbox="909 411 1032 475">0.92</td> <td data-bbox="1032 411 1182 475">349</td> <td data-bbox="1182 411 1323 475">2.87</td> <td data-bbox="1323 411 1496 475">-0.0369</td> <td data-bbox="1496 411 1671 475">-0.0372</td> <td data-bbox="1671 411 1854 475">-0.0362</td> </tr> <tr> <td data-bbox="342 475 539 539">0.0178</td> <td data-bbox="539 475 734 539">0.84889...</td> <td data-bbox="734 475 909 539">0.849</td> <td data-bbox="909 475 1032 539">0.85</td> <td data-bbox="1032 475 1182 539">345</td> <td data-bbox="1182 475 1323 539">2.90</td> <td data-bbox="1323 475 1496 539">-0.0711</td> <td data-bbox="1496 475 1671 539">-0.0711</td> <td data-bbox="1671 475 1854 539">-0.0706</td> </tr> <tr> <td data-bbox="342 539 539 603">0.0266</td> <td data-bbox="539 539 734 603">0.78988...</td> <td data-bbox="734 539 909 603">0.790</td> <td data-bbox="909 539 1032 603">0.79</td> <td data-bbox="1032 539 1182 603">341</td> <td data-bbox="1182 539 1323 603">2.93</td> <td data-bbox="1323 539 1496 603">-0.102</td> <td data-bbox="1496 539 1671 603">-0.102</td> <td data-bbox="1671 539 1854 603">-0.102</td> </tr> <tr> <td data-bbox="342 603 539 667">0.0355</td> <td data-bbox="539 603 734 667">0.73800...</td> <td data-bbox="734 603 909 667">0.738</td> <td data-bbox="909 603 1032 667">0.74</td> <td data-bbox="1032 603 1182 667">338</td> <td data-bbox="1182 603 1323 667">2.96</td> <td data-bbox="1323 603 1496 667">-0.132</td> <td data-bbox="1496 603 1671 667">-0.132</td> <td data-bbox="1671 603 1854 667">-0.131</td> </tr> <tr> <td data-bbox="342 667 539 730">0.0444</td> <td data-bbox="539 667 734 730">0.69252...</td> <td data-bbox="734 667 909 730">0.693</td> <td data-bbox="909 667 1032 730">0.69</td> <td data-bbox="1032 667 1182 730">334</td> <td data-bbox="1182 667 1323 730">2.99</td> <td data-bbox="1323 667 1496 730">-0.160</td> <td data-bbox="1496 667 1671 730">-0.159</td> <td data-bbox="1671 667 1854 730">-0.161</td> </tr> <tr> <td data-bbox="342 730 539 794">0.0533</td> <td data-bbox="539 730 734 794">0.65231...</td> <td data-bbox="734 730 909 794">0.652</td> <td data-bbox="909 730 1032 794">0.65</td> <td data-bbox="1032 730 1182 794">331</td> <td data-bbox="1182 730 1323 794">3.02</td> <td data-bbox="1323 730 1496 794">-0.186</td> <td data-bbox="1496 730 1671 794">-0.186</td> <td data-bbox="1671 730 1854 794">-0.187</td> </tr> <tr> <td data-bbox="342 794 539 858">0.0621</td> <td data-bbox="539 794 734 858">0.61690...</td> <td data-bbox="734 794 909 858">0.617</td> <td data-bbox="909 794 1032 858">0.62</td> <td data-bbox="1032 794 1182 858">329</td> <td data-bbox="1182 794 1323 858">3.04</td> <td data-bbox="1323 794 1496 858">-0.210</td> <td data-bbox="1496 794 1671 858">-0.210</td> <td data-bbox="1671 794 1854 858">-0.208</td> </tr> <tr> <td data-bbox="342 858 539 938">0.0769</td> <td data-bbox="539 858 734 938">0.56529...</td> <td data-bbox="734 858 909 938">0.565</td> <td data-bbox="909 858 1032 938">0.57</td> <td data-bbox="1032 858 1182 938">325</td> <td data-bbox="1182 858 1323 938">3.08</td> <td data-bbox="1323 858 1496 938">-0.248</td> <td data-bbox="1496 858 1671 938">-0.248</td> <td data-bbox="1671 858 1854 938">-0.244</td> </tr> </tbody> </table> <p data-bbox="342 978 629 1034">M1: for column 4, $(\frac{1}{T_m})$</p> <p data-bbox="342 1042 658 1090">M2: for column 5 (log Y)</p> <p data-bbox="342 1114 882 1153">M3: All values in columns 4 and 5 to 3 SF</p>									Mol	Y			temp	$1/T_m$	Log Y			0.00	1.00...	1.00	1.00	353	2.83	0.00	0.00	0.00	0.00888	0.91844...	0.918	0.92	349	2.87	-0.0369	-0.0372	-0.0362	0.0178	0.84889...	0.849	0.85	345	2.90	-0.0711	-0.0711	-0.0706	0.0266	0.78988...	0.790	0.79	341	2.93	-0.102	-0.102	-0.102	0.0355	0.73800...	0.738	0.74	338	2.96	-0.132	-0.132	-0.131	0.0444	0.69252...	0.693	0.69	334	2.99	-0.160	-0.159	-0.161	0.0533	0.65231...	0.652	0.65	331	3.02	-0.186	-0.186	-0.187	0.0621	0.61690...	0.617	0.62	329	3.04	-0.210	-0.210	-0.208	0.0769	0.56529...	0.565	0.57	325	3.08	-0.248	-0.248	-0.244	3
Mol	Y			temp	$1/T_m$	Log Y																																																																																														
0.00	1.00...	1.00	1.00	353	2.83	0.00	0.00	0.00																																																																																												
0.00888	0.91844...	0.918	0.92	349	2.87	-0.0369	-0.0372	-0.0362																																																																																												
0.0178	0.84889...	0.849	0.85	345	2.90	-0.0711	-0.0711	-0.0706																																																																																												
0.0266	0.78988...	0.790	0.79	341	2.93	-0.102	-0.102	-0.102																																																																																												
0.0355	0.73800...	0.738	0.74	338	2.96	-0.132	-0.132	-0.131																																																																																												
0.0444	0.69252...	0.693	0.69	334	2.99	-0.160	-0.159	-0.161																																																																																												
0.0533	0.65231...	0.652	0.65	331	3.02	-0.186	-0.186	-0.187																																																																																												
0.0621	0.61690...	0.617	0.62	329	3.04	-0.210	-0.210	-0.208																																																																																												
0.0769	0.56529...	0.565	0.57	325	3.08	-0.248	-0.248	-0.244																																																																																												
2(b)	<p data-bbox="342 1182 1025 1222">M1: nine points plotted correctly including 2.83, 0.00.</p> <p data-bbox="342 1246 748 1286">M2: best-fit straight line drawn</p>									2																																																																																										
2(c)(i)	<p data-bbox="342 1315 891 1355">M1: coordinates read & recorded correctly</p> <p data-bbox="342 1378 663 1418">M2: gradient determined</p>									2																																																																																										

PUBLISHED

Question	Answer	Marks
2(c)(ii)	$\frac{-\Delta H_{\text{fusion}}}{2.30 \times R} \Delta H_{\text{fusion}} = (-\mathbf{2(c)(i)} \times 2.30 \times 8.31) / 1000$	1
2(d)(i)	<p>Yes, (the data is reliable because) AND</p> <p>there are no anomalous points OR only 1, 2 or 3 anomalous points OR only a few points are not on/near the line OR most points on the line OR all the points are on the line OR</p> <p>No AND one or more anomalous points OR one or more points away from the line</p>	1
2(d)(ii)	<p>M1: <i>literature values:</i> lower limit = $1.45 \div (10.00/128.0) = 18.56$ (kJ mol⁻¹) AND upper limit = $1.47 \div (10.00/128.0) = 18.82 / 18.816$ (kJ mol⁻¹)</p> <p>M2: experiment is not (very) accurate because experimental ΔH_{fusion} is outside literature range</p>	2
2(e)	<p>M1: (on mixing) ΔH_1 would be more positive</p> <p>M2: ΔH_{mixing} is positive / >0 OR $\Delta H_1 = \Delta H_{\text{fusion}} + \Delta H_{\text{mixing}}$</p>	2
2(f)(i)	<p>Y is smaller AND because n_{D} is larger (and $Y = \frac{n_{\text{N}}}{n_{\text{N}} + n_{\text{D}}}$)</p>	1

PUBLISHED

Question	Answer	Marks
2(f)(ii)	<p>If Y is smaller in 2(f)(i) M1: ΔH_{fusion} will be more positive (than actual value)</p> <p>M2: log Y is more negative OR Gradient is more negative</p> <p>If Y is greater in 2(f)(i) M1: ΔH_{fusion} will be less positive (than actual value)</p> <p>M2: log Y is less negative OR Gradient is less negative</p>	2