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**CHEMISTRY**

**9701/53**

Paper 5 Planning, Analysis and Evaluation

**May/June 2018**

MARK SCHEME

Maximum Mark: 30

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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 2018 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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**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)	Complete circuit with ammeter in series and DC power supply	1
	Anode, cathode and solution labelled	1
1(b)	wear gloves	1
	do not dispose into the water waste / sink <b>OR</b> do not put down drain / sewage <b>OR</b> put in waste bottles	1
1(c)	Mass (of electrode) before and after experiment <b>AND</b> mass unit	1
1(d)	charge = $0.5 \cdot 30 \cdot 60 = 900$ C	1
1(e)	$0.282 / 63.5 = 4.44 \cdot 10^{-3}$ (mol) <b>OR</b> 0.00444	1
1(f)	$(900 / 4.44 \cdot 10^{-3}) = 202702.7027$ C	1
1(g)	2 moles of electrons are <b>produced</b> / removed / released (so 2 Faradays <b>OR</b> $2 \cdot 96\,500$ )	1
1(h)	(Faraday) value is smaller <b>AND</b> (apparent) mass / moles / amount is more (for same charge passed)	1
1(i)	CuO is formed / oxidation of copper / carbon / soot is formed	1
1(j)	Some copper falls off the electrode during electrolysis / falls to the bottom of the beaker <b>OR</b> Some copper is lost during washing	1

Question	Answer	Marks
2(a)	Water bath/beaker of water containing thermometer around flask	1
	Controlled heat source or heater/temperature regulator	1
2(b)(i)	Moles $N_2 = 72 / 24\,000 = 0.003$ moles (1 mol $C_6H_5N_2^+Cl^- \rightarrow 1$ mol $N_2$ )	1
	Moles $C_6H_5N_2^+$ in $1000\text{ cm}^3$ solution = $0.003 \cdot (1000 / 200) = 1.50 \cdot 10^{-2}$ (mol)	1
2(b)(ii)	<p style="text-align: center;">OR</p>	
	Axes (label with quantity or correct unit) and values correct	1
	Straight line from axis marks <b>OR</b> from 0,0 over most of the axes	1

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Question	Answer				Marks																																												
2(c)	<table border="1"> <thead> <tr> <th data-bbox="595 217 824 268">A</th> <th data-bbox="824 217 1050 268">B</th> <th data-bbox="1050 217 1276 268">C</th> <th data-bbox="1276 217 1677 268">D</th> </tr> <tr> <th data-bbox="595 268 824 387">Time / min</th> <th data-bbox="824 268 1050 387">volume of nitrogen, V / cm<sup>3</sup></th> <th data-bbox="1050 268 1276 387">V / V<sub>FINAL</sub></th> <th data-bbox="1276 268 1677 387">[C<sub>6</sub>H<sub>5</sub>N<sub>2</sub><sup>+</sup>Cl<sup>-</sup>(aq)] / mol dm<sup>-3</sup></th> </tr> </thead> <tbody> <tr> <td data-bbox="595 387 824 438">0.0</td> <td data-bbox="824 387 1050 438">0</td> <td data-bbox="1050 387 1276 438">0.000</td> <td data-bbox="1276 387 1677 438">0.0150</td> </tr> <tr> <td data-bbox="595 438 824 489">2.0</td> <td data-bbox="824 438 1050 489">9</td> <td data-bbox="1050 438 1276 489">0.125</td> <td data-bbox="1276 438 1677 489">0.0131</td> </tr> <tr> <td data-bbox="595 489 824 541">4.0</td> <td data-bbox="824 489 1050 541">17</td> <td data-bbox="1050 489 1276 541">0.236</td> <td data-bbox="1276 489 1677 541">0.0115</td> </tr> <tr> <td data-bbox="595 541 824 592">6.0</td> <td data-bbox="824 541 1050 592">24</td> <td data-bbox="1050 541 1276 592">0.333</td> <td data-bbox="1276 541 1677 592">0.0100</td> </tr> <tr> <td data-bbox="595 592 824 643">8.0</td> <td data-bbox="824 592 1050 643">30</td> <td data-bbox="1050 592 1276 643">0.417</td> <td data-bbox="1276 592 1677 643">0.00875</td> </tr> <tr> <td data-bbox="595 643 824 694">10.0</td> <td data-bbox="824 643 1050 694">35</td> <td data-bbox="1050 643 1276 694">0.486</td> <td data-bbox="1276 643 1677 694">0.00771</td> </tr> <tr> <td data-bbox="595 694 824 745">12.0</td> <td data-bbox="824 694 1050 745">40</td> <td data-bbox="1050 694 1276 745">0.556</td> <td data-bbox="1276 694 1677 745">0.00666</td> </tr> <tr> <td data-bbox="595 745 824 796">14.0</td> <td data-bbox="824 745 1050 796">44</td> <td data-bbox="1050 745 1276 796">0.611</td> <td data-bbox="1276 745 1677 796">0.00584</td> </tr> <tr> <td data-bbox="595 796 824 842">16.0</td> <td data-bbox="824 796 1050 842">48</td> <td data-bbox="1050 796 1276 842">0.667</td> <td data-bbox="1276 796 1677 842">0.00500</td> </tr> </tbody> </table>				A	B	C	D	Time / min	volume of nitrogen, V / cm <sup>3</sup>	V / V <sub>FINAL</sub>	[C <sub>6</sub> H <sub>5</sub> N <sub>2</sub> <sup>+</sup> Cl <sup>-</sup> (aq)] / mol dm <sup>-3</sup>	0.0	0	0.000	0.0150	2.0	9	0.125	0.0131	4.0	17	0.236	0.0115	6.0	24	0.333	0.0100	8.0	30	0.417	0.00875	10.0	35	0.486	0.00771	12.0	40	0.556	0.00666	14.0	44	0.611	0.00584	16.0	48	0.667	0.00500	
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	3 sf in <b>C</b> and <b>D</b>				<b>1</b>																																												
2(d)	Candidate's calculated points correctly plotted from table in <b>2(c)</b>				<b>1</b>																																												
	Smooth curve of best fit				<b>1</b>																																												
2(e)	Tangent drawn at time zero				<b>1</b>																																												
	2 sets of co-ordinates shown				<b>1</b>																																												
	calculation of gradient of tangent				<b>1</b>																																												
	mol dm <sup>-3</sup> minute(s) <sup>-1</sup>				<b>1</b>																																												

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Columns 2 and 4					<b>1</b>																
Half-lives correctly calculated.					<b>1</b>																
2(g)	First order <b>AND</b> because half-lives are constant/equal					<b>1</b>															