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 **May/June 2018**

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.

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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)	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 **OR** do not put down drain / sewage **OR** put in waste bottles	**1**
1(c)	Mass (of electrode) before and after experiment **AND** mass unit	**1**
1(d)	charge = 0.5 · 30 · 60 = 900 C	**1**
1(e)	0.282 / 63.5 = 4.44 · 10^{-3} (mol) **OR** 0.00444	**1**
1(f)	(900 / 4.44 · 10^{-3})= 202702.7027 C	**1**
1(g)	2 moles of electrons are **produced** / removed / released (so 2 Faradays **OR** 2 · 96 500)	**1**
1(h)	(Faraday) value is smaller **AND** (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 **OR** Some copper is lost during washing	**1**

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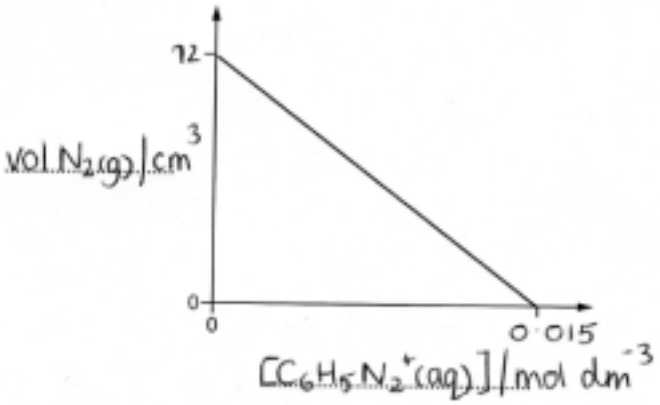
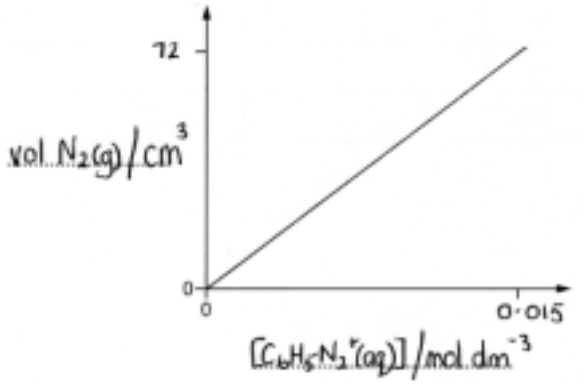
Question	Answer	Marks
2(a)	Water bath/beaker of water containing thermometer around flask	**1**
	Controlled heat source or heater/temperature regulator	**1**
2(b)(i)	Moles N_2 = 72 / 24 000 = 0.003 moles (1 mol $C_6H_5N_2^+Cl^- \rightarrow$ 1 mol N_2)	**1**
	Moles $C_6H_5N_2^+$ in 1000 cm^3 solution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

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(c)</td><td>
<table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th></tr>
<tr><td>Time / min</td><td>volume of nitrogen, V / cm^3</td><td>V / V_{FINAL}</td><td>$[C_6H_5N_2^+Cl^-(aq)]$ / mol dm^{-3}</td></tr>
<tr><td>0.0</td><td>0</td><td>0.000</td><td>0.0150</td></tr>
<tr><td>2.0</td><td>9</td><td>0.125</td><td>0.0131</td></tr>
<tr><td>4.0</td><td>17</td><td>0.236</td><td>0.0115</td></tr>
<tr><td>6.0</td><td>24</td><td>0.333</td><td>0.0100</td></tr>
<tr><td>8.0</td><td>30</td><td>0.417</td><td>0.00875</td></tr>
<tr><td>10.0</td><td>35</td><td>0.486</td><td>0.00771</td></tr>
<tr><td>12.0</td><td>40</td><td>0.556</td><td>0.00666</td></tr>
<tr><td>14.0</td><td>44</td><td>0.611</td><td>0.00584</td></tr>
<tr><td>16.0</td><td>48</td><td>0.667</td><td>0.00500</td></tr>
</table>
</td><td></td></tr>
<tr><td></td><td>Column values for D correctly calculated</td><td>1</td></tr>
<tr><td></td><td>3 sf in C and D</td><td>1</td></tr>
<tr><td>2(d)</td><td>Candidate’s calculated points correctly plotted from table in 2(c)</td><td>1</td></tr>
<tr><td></td><td>Smooth curve of best fit</td><td>1</td></tr>
<tr><td>2(e)</td><td>Tangent drawn at time zero</td><td>1</td></tr>
<tr><td></td><td>2 sets of co-ordinates shown</td><td>1</td></tr>
<tr><td></td><td>calculation of gradient of tangent</td><td>1</td></tr>
<tr><td></td><td>mol dm^{-3} $minute(s)^{-1}$</td><td>1</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="4">2(f)</td><td>
<table>
<tr><td>concentration 1</td><td>Time 1</td><td>concentration 2</td><td>time 2</td><td>$t_{1/2}$</td></tr>
<tr><td>(0.0120)</td><td>3</td><td>(0.0060)</td><td>13.4</td><td>10.4</td></tr>
<tr><td>0.010</td><td>6</td><td>0.005</td><td>16.0</td><td>10.0</td></tr>
</table>
</td><td></td></tr>
<tr><td>Columns 1 and 3</td><td>1</td></tr>
<tr><td>Columns 2 and 4</td><td>1</td></tr>
<tr><td>Half-lives correctly calculated.</td><td>1</td></tr>
<tr><td>2(g)</td><td>First order AND because half-lives are constant/equal</td><td>1</td></tr>
</table>

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