
CHEMISTRY

9701/53

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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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.

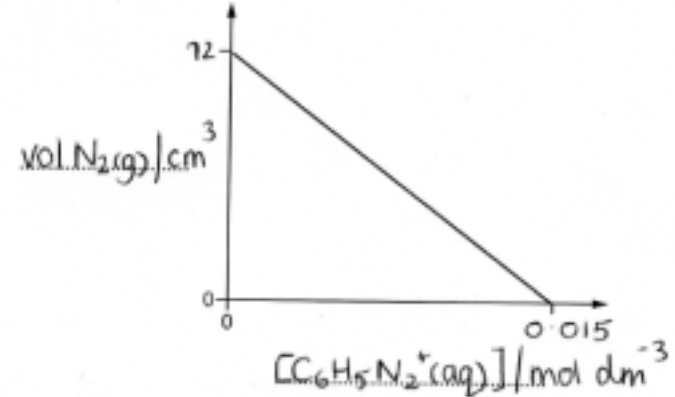
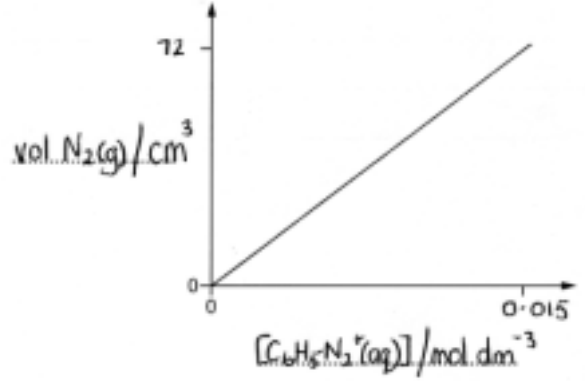
GENERIC MARKING PRINCIPLE 5:

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.

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 = $0.5 \times 30 \times 60 = 900$ C	1
1(e)	$0.282 / 63.5 = 4.44 \times 10^{-3}$ (mol) OR 0.00444	1
1(f)	$(900 / 4.44 \times 10^{-3}) = 202702.7027$ C	1
1(g)	2 moles of electrons are produced / removed / released (so 2 Faradays OR $2 \times 96\,500$)	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

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 = $0.003 \times (1000 / 200) = 1.50 \times 10^{-2}$ (mol)	1
2(b)(ii)	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;">OR</div> <div style="text-align: center;">  </div> </div>	
	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

Question	Answer				Marks																																												
2(c)	<table border="1"> <thead> <tr> <th data-bbox="595 218 824 268">A</th> <th data-bbox="824 218 1050 268">B</th> <th data-bbox="1050 218 1276 268">C</th> <th data-bbox="1276 218 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^3</th> <th data-bbox="1050 268 1276 387">V / V_{FINAL}</th> <th data-bbox="1276 268 1677 387">$[\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-(\text{aq})] / \text{mol dm}^{-3}$</th> </tr> </thead> <tbody> <tr> <td data-bbox="595 387 824 437">0.0</td> <td data-bbox="824 387 1050 437">0</td> <td data-bbox="1050 387 1276 437">0.000</td> <td data-bbox="1276 387 1677 437">0.0150</td> </tr> <tr> <td data-bbox="595 437 824 486">2.0</td> <td data-bbox="824 437 1050 486">9</td> <td data-bbox="1050 437 1276 486">0.125</td> <td data-bbox="1276 437 1677 486">0.0131</td> </tr> <tr> <td data-bbox="595 486 824 536">4.0</td> <td data-bbox="824 486 1050 536">17</td> <td data-bbox="1050 486 1276 536">0.236</td> <td data-bbox="1276 486 1677 536">0.0115</td> </tr> <tr> <td data-bbox="595 536 824 585">6.0</td> <td data-bbox="824 536 1050 585">24</td> <td data-bbox="1050 536 1276 585">0.333</td> <td data-bbox="1276 536 1677 585">0.0100</td> </tr> <tr> <td data-bbox="595 585 824 635">8.0</td> <td data-bbox="824 585 1050 635">30</td> <td data-bbox="1050 585 1276 635">0.417</td> <td data-bbox="1276 585 1677 635">0.00875</td> </tr> <tr> <td data-bbox="595 635 824 684">10.0</td> <td data-bbox="824 635 1050 684">35</td> <td data-bbox="1050 635 1276 684">0.486</td> <td data-bbox="1276 635 1677 684">0.00771</td> </tr> <tr> <td data-bbox="595 684 824 734">12.0</td> <td data-bbox="824 684 1050 734">40</td> <td data-bbox="1050 684 1276 734">0.556</td> <td data-bbox="1276 684 1677 734">0.00666</td> </tr> <tr> <td data-bbox="595 734 824 783">14.0</td> <td data-bbox="824 734 1050 783">44</td> <td data-bbox="1050 734 1276 783">0.611</td> <td data-bbox="1276 734 1677 783">0.00584</td> </tr> <tr> <td data-bbox="595 783 824 833">16.0</td> <td data-bbox="824 783 1050 833">48</td> <td data-bbox="1050 783 1276 833">0.667</td> <td data-bbox="1276 783 1677 833">0.00500</td> </tr> </tbody> </table>				A	B	C	D	Time / min	volume of nitrogen, V / cm^3	V / V_{FINAL}	$[\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-(\text{aq})] / \text{mol dm}^{-3}$	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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	Column values for D correctly calculated				1																																												
	3 sf in C and D				1																																												
2(d)	Candidate's calculated points correctly plotted from table in 2(c)				1																																												
	Smooth curve of best fit				1																																												
2(e)	Tangent drawn at time zero				1																																												
	2 sets of co-ordinates shown				1																																												
	calculation of gradient of tangent				1																																												
	$\text{mol dm}^{-3} \text{ minute(s)}^{-1}$				1																																												

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