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**CHEMISTRY**

**9701/35**

Paper 3 Advanced Practical Skills 1

**May/June 2016**

MARK SCHEME

Maximum Mark: 40

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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.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2016	9701	35

Question	Indicative material	Mark	Total
1 (a)	I Initial and final readings <b>and</b> titre value given for rough titre <b>and</b> initial and final readings for two (or more) accurate titrations ( <i>minimum of 2 x 2 box</i> )	1	
	II Titre values recorded for accurate titrations <b>and</b> Appropriate headings for the <b>accurate</b> titration table <b>and</b> cm <sup>3</sup> units. <ul style="list-style-type: none"> <li>initial / start burette reading / volume / value</li> <li>final / end burette and reading / volume / value</li> <li>titre <b>or</b> volume / <b>FA2 and</b> used / added</li> </ul> unit: / cm <sup>3</sup> <b>or</b> (cm <sup>3</sup> ) <b>or</b> in cm <sup>3</sup> <b>or</b> cm <sup>3</sup> (for each heading)	1	
	III All <b>accurate</b> burette readings recorded to the nearest 0.05 cm <sup>3</sup> . <i>Do not award this mark if:</i> <ul style="list-style-type: none"> <li>50(.00) is used as an initial burette reading</li> <li>more than one final burette reading is 50(.00)</li> <li>any burette reading is greater than 50(.00)</li> </ul>	1	
	IV There are two (or more) uncorrected, <b>accurate</b> titres within 0.10 cm <sup>3</sup> <ul style="list-style-type: none"> <li><i>Do not award this mark if, having performed two titres within 0.1 cm<sup>3</sup>, a further titration is performed which is more than 0.10 cm<sup>3</sup> from the closer of the two initial titres, unless a further titration, within 0.10 cm<sup>3</sup> of any other, has also been carried out.</i></li> <li><i>Do not award the mark if any “accurate” burette readings (apart from initial 0 cm<sup>3</sup>) are given to zero dp.</i></li> </ul>	1	
	V, VI and VII Examiner rounds any accurate burette to the nearest 0.05 cm <sup>3</sup> , checks subtractions and then select the ‘best’ titres using the hierarchy: <ul style="list-style-type: none"> <li>two (or more) accurate identical titres, <i>then</i></li> <li>two (or more) accurate titres within 0.05 cm<sup>3</sup>, <i>then</i></li> <li>two (or more) accurate titres within 0.10 cm<sup>3</sup>, <i>etc.</i></li> </ul> These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm <sup>3</sup> .  Accuracy marks are awarded as shown.  Award V, VI and VII if $\delta \leq 0.20 \text{ cm}^3$ Award V and VI if $0.20 < \delta \leq 0.40 \text{ cm}^3$ Award V only if $0.40 < \delta \leq 0.60 \text{ cm}^3$	3	

[7]

Page 3	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
(b)	<p>Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm<sup>3</sup>. Working must be shown <b>or</b> ticks must be put next to the two (or more) accurate readings selected. The mean should be quoted to <b>2 dp</b>, rounded to the nearest 0.01.</p> <p>Two special cases where the mean may not be to 2 dp:</p> <ul style="list-style-type: none"> <li>• Allow mean expressed to 3 dp <b>only</b> for 0.025 or 0.075 (e.g. 26.325)</li> <li>• Allow mean if expressed to 1 dp if <b>all</b> accurate burette readings were given to 1 dp <b>and</b> the mean is <b>exactly</b> correct. (e.g. 26.0 and 26.2 = 26.1 is allowed) (e.g. 26.0 and 26.1 = 26.1 is incorrect – should be 26.05.)</li> </ul> <p><b>Note:</b> the candidate's mean will sometimes be marked as correct even if it is different from the mean calculated by the examiner for the purpose of assessing accuracy.</p>	1	[1]
(c) (i)	Correctly calculates $n(\text{NaOH}) \text{ used} = \frac{4.20}{40.0} \times \frac{(b)}{1000}$	1	[5]
(ii)	Equation correct $2\text{NaOH}(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$ State and symbols must be correct	1	
(iii)	<b>and</b> answer (i) divided by 2		
(iv)	Correct use of $40 \times$ answer (iii)	1	
(v)	Correct use of $25 \times$ answer (iv)	1	
	All answers to 3 or 4 significant figures (minimum 3 answers attempted)	1	
Question 1			[13]

Page 4	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
2 (a) (i)	Tables/lists of data in (a) and (b) <ul style="list-style-type: none"> <li>• Three unambiguous headings</li> <li>• Unit 'covering' all temperatures</li> <li>• Four thermometer readings recorded</li> <li>• Two temperature changes recorded</li> </ul>	1	[6]
	Readings and subtraction in (a) and (b) <ul style="list-style-type: none"> <li>• All four thermometer readings recorded to 0.0 or 0.5 °C</li> <li>• Both temperature changes correctly subtracted</li> </ul>	1	
	Accuracy mark awarded as shown.  <i>Examiner checks subtractions and compares the candidate's temperature rise with the Supervisor's. The difference is <math>\delta</math>.</i> If $\delta \leq 1.0$ °C, award <b>one</b> mark If $\Delta T \geq 20.0$ °C then award for $\delta \leq 2.0$ °C	1	
(ii)	Correctly calculates energy produced in (a) Energy produced = $25 \times 4.2 \times$ temperature change  <i>Answer correct to 2 to 4 significant figures.</i>	1	
(iii)	Correctly calculates $n(\text{H}_2\text{SO}_4) = 0.025 \times \mathbf{1(c)(v)}$  <i>Answer must be correct to 2, 3 or 4 significant figures.</i>	1	
(iv)	Correct expression and negative sign Enthalpy change = $-\frac{\mathbf{ans(ii)}}{\mathbf{ans(iii)}} \times \frac{1}{1000}$  <i>Answer must be correct to 2, 3 or 4 significant figures.</i>	1	
(b) (i)	Accuracy mark awarded as shown.  <i>Examiner checks subtractions and compares the candidate's temperature rise with the supervisor's. The difference is <math>\delta</math></i> <ul style="list-style-type: none"> <li>• If <math>\delta \leq 1.0</math> °C, award <b>two</b> Q marks</li> <li>• If <math>1.0 &lt; \delta \leq 2.0</math> °C, award <b>one</b> Q mark</li> </ul>	2	[4]
(ii)	Correctly calculates energy produced in (b) <ul style="list-style-type: none"> <li>• Energy produced = <math>25 \times 4.2 \times</math> temp rise</li> <li>• Answer correct and expressed to 2, 3 or 4 significant figures.</li> </ul>	1	
(iii)	Correct expression and negative sign Enthalpy change = $\frac{\mathbf{answer(b)(ii)}}{\mathbf{(a)(iii)}} \times \frac{1}{1000}$  <i>Answer must be correct to 2, 3 or 4 significant figures.</i>	1	

Page 5	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
(c)	Attempt at a Hess' Law energy cycle <ul style="list-style-type: none"> <li>• Two correct arrows from the equation</li> <li>• Left arrow labelled with <b>(a)(iv)</b> or numerical value</li> <li>• Right arrow labelled with <b>(b)(iii)</b> or numerical value</li> </ul>	1	[2]
	Correctly calculates enthalpy change Answer = <b>(a)(iv) – (b)(iii)</b>	1	
(d) (i)	% error = $\frac{2 \times 0.5}{\text{temp rise in (b)}} \times 100$	1	[2]
(ii)	The student is wrong because MgO is in excess <b>or</b> The student is wrong because H <sub>2</sub> SO <sub>4</sub> is the limiting reagent	1	
Question 2			[14]

Page 6	Mark Scheme	Syllabus	Paper
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Question	Indicative material	Mark	Total
<b>FA 6 is Mg(NO<sub>3</sub>)<sub>2</sub>; FA 7 is KI + ZnSO<sub>4</sub> (= ZnI<sub>2</sub>)</b>			
<b>3 (a) (i)</b>	Observations <ul style="list-style-type: none"> <li>• (On gentle heating) it melts/dissolves <b>or</b> changes to liquid</li> <li>• Condensation inside tube <b>or</b> steam evolved <b>or</b> fizz/bubbles</li> <li>• (On strong heating) white residue/solid formed</li> <li>• Brown gas/fumes liberated</li> <li>• (Moist blue) litmus turns red</li> <li>• Gas/oxygen relights a glowing spill (or makes it glow brighter)</li> </ul> <i>5 or 6 observations correct = 3 marks</i> <i>3 or 4 observations correct = 2 marks</i> <i>1 or 2 observations correct = 1 mark</i>	3	
	<b>(ii)</b> Observations in first two tests <ul style="list-style-type: none"> <li>• With H<sub>2</sub>SO<sub>4</sub> – no reaction/no change</li> <li>• With ammonia – white precipitate, insoluble/no change in excess</li> <li>• With cold NaOH - white precipitate <b>and</b> no change/insoluble excess</li> </ul>	1  1	
	Subsequent observations <ul style="list-style-type: none"> <li>• Ignore observation on heating alone unless a gas is identified <b>or</b> litmus turns blue</li> <li>• When Al is added, gas/NH<sub>3</sub> turns litmus blue</li> </ul>	1	
<b>(iii)</b>	Conclusion <b>FA 6</b> is Mg(NO <sub>3</sub> ) <sub>2</sub>	1	
	$Mg^{2+}(aq) + 2OH^{-}(aq) \rightarrow Mg(OH)_2(s)$	1	[8]
<b>(b) (i)</b>	Observation with NaOH White precipitate (forms) <b>and</b> soluble in excess (NaOH)	1	
	Observation with NH <sub>3</sub> White precipitate (forms) <b>and</b> soluble in excess (NH <sub>3</sub> )	1	
	Both observations required <ul style="list-style-type: none"> <li>• Brown/orange/red-brown/yellow/yellow-brown (solution) formed <b>and</b></li> <li>• Goes dark blue/black/blue-black when starch added</li> </ul>	1	
<b>(ii)</b>	Conclusion <b>FA 7</b> is zinc iodide/ZnI <sub>2</sub>	1	
	Correct test and result <ul style="list-style-type: none"> <li>• Add silver nitrate</li> <li>• Yellow precipitate formed</li> </ul>	1	[5]
<b>Question 3</b>			<b>[13]</b>