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**CHEMISTRY**

**9701/03**

Paper 3 Advanced Practical Skills

**For Examination from 2016**

SPECIMEN MARK SCHEME

**2 hours**

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**MAXIMUM MARK: 40**

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This document consists of **6** printed pages.

Question	Sections	Indicative material	Mark
1 (a)	PDO Recording	Both balance readings and the correctly calculated mass of marble chips are recorded.	1
		Both balance readings are recorded to the same level of precision <b>and</b> all volumes are recorded to the same level of precision.	1
	MMO Quality	$\delta V$ decreases with time ( $\delta V = (V \text{ at } 2 \text{ min}) - (V \text{ at } 1 \text{ min}) >$ ( $V \text{ at } 3 \text{ min}) - (V \text{ at } 2 \text{ min})$ etc.) (Allow $\delta V = 0$ for $t = 9 \rightarrow 10$ min)	1  [3]
(b) (i)	PDO Layout	Scales chosen so that graph occupies more than half the available length for x- and y-axes and y-axis labelled volume or $V/\text{cm}^3$ or $(\text{cm}^3)$ and x-axis labelled time or $t/\text{minutes}$ or min.  <b>All</b> points plotted to within half a small square in the y-direction and the centre of the dot/cross on the line in the x-direction.	1  1 [2]
	(ii)	Appropriate line of best fit drawn.	1 [1]
(iii)	PDO Display	Appropriate tangent drawn on graph (line must be at least 10 cm long) and triangle drawn to obtain values for the gradient.	1
	ACE Interpretation	Correctly calculates the gradient of the tangent drawn.	1 [2]
(iv)	ACE Conclusions	Curve (of decreasing gradient) indicates rate of reaction decreasing.	1
		Factor: acid concentration decreasing with time <b>or</b> surface area of marble chip decreasing with time	1
		Explanation: less frequent collisions <b>because</b> fewer (acid) particles/ $\text{H}^+$ (ions) per unit volume <b>or</b> fewer surface particles/sites for reaction	1 [3]
(c)	ACE Interpretation	One of: $\text{CO}_2$ /gas lost before bung replaced (smaller volume than expected); $\text{CO}_2$ slightly soluble in water (smaller volume than expected); delay in starting stopwatch (greater volume than expected); inserting the bung displaces air (greater volume than expected)	1

Question	Sections	Indicative material	Mark
(c) (cont.)	ACE Improvements	Improvement must match inaccuracy.  One of: arrange marble chips in flask so mixing is carried out after bung replaced; use gas syringe/saturate water with CO <sub>2</sub> before experiment; observe clock with second hand sweep/ask for assistance; check volume of air displaced before experiment and subtract	1             [2]
<b>Qn 1</b>		<b>Total</b>	<b>13</b>

Question	Sections	Indicative material	Mark
<b>2 (a) (i)</b>	MMO Collection	Initial and final burette readings recorded for dilution, volume of <b>FA 2</b> diluted recorded <b>and</b> the value is between 9 and 12 cm <sup>3</sup> .	1  [1]
<b>(ii)</b>	PDO Layout	Volume given for rough titre <b>and</b> accurate titre details tabulated. (Minimum 2 × 2 boxes)	1
	MMO Collection	Initial and final burette readings recorded for rough and accurate titres <b>and</b> titre volumes recorded.	1
	PDO Recording	Headings and units correct for accurate titration. Initial/final (burette) reading/volume or reading/volume at start/finish and titre or volume/ <b>FA 4</b> added/used <b>and</b> /cm <sup>3</sup> or (cm <sup>3</sup> ).	1
	MMO Decisions	All accurate burette readings to 0.05 cm <sup>3</sup> (for dilution and accurate titration).  Has two uncorrected accurate titres within 0.1 cm <sup>3</sup> . Do not award if, having performed two titres within 0.1 cm <sup>3</sup> , a further titration has been performed that is more than 0.1 cm <sup>3</sup> from the closer of the original 2 titres unless a further titration has been carried out which is within 0.1 cm <sup>3</sup> of any of the others.  Do not award if titres from burette readings to 0 dp are used (apart from use of 0 for initial reading).	1
<p>Examiner rounds any accurate burette readings to the nearest 0.05 cm<sup>3</sup>, checks subtractions and then select the '<b>best</b>' titres for Supervisor and candidate using the hierarchy</p> <p><i>two identical titres; titres within 0.05 cm<sup>3</sup>; titres within 0.1 cm<sup>3</sup>; etc.</i></p> <p>to calculate mean correct to 0.01 cm<sup>3</sup>.</p> <p>Write ringed Supervisor value on candidate's script. Calculate scaled candidate titre</p> $= \frac{\text{candidate mean titre} \times \text{candidate volume diluted}}{\text{Supervisor volume diluted}}$ <p>Record calculated value, difference from Supervisor, <math>\delta</math>, and any spread penalty on the candidate's script.</p>			
	MMO Quality	Award 3 marks for $\delta \leq 0.20 \text{ cm}^3$ . Award 2 marks for $0.20 \text{ cm}^3 < \delta \leq 0.40 \text{ cm}^3$ . Award 1 mark for $0.40 \text{ cm}^3 < \delta \leq 0.60 \text{ cm}^3$ . Apply <b>spread penalty</b> of -1 from the Quality marks as follows: titres selected (by Examiner) differ $\geq 0.50 \text{ cm}^3$ .	3  [8]
<b>(b)</b>	ACE Interpretation	Check mean titre correctly calculated to 2 dp from clearly selected values (ticks or working) and correct subtractions. Candidate must average two (or more) <b>accurate</b> titres that are within 0.20 cm <sup>3</sup> of each other.	1  [1]
<b>(c) (i)</b>	ACE Interpretation	Correctly calculates $0.1 \times 25/1000$ <b>and</b> same answer for moles of HCl	1  [1]
<b>(ii)</b>		Correctly calculates <b>(i)</b> × 250/volume in <b>(b)</b>	1 [1]

Question	Sections	Indicative material	Mark
(iii)	ACE Conclusions	Correctly calculates <b>(ii)</b> $\times$ 1000/volume diluted in <b>(a)</b>	1 [1]
(iv)	PDO Display	All final answers recorded to 3 or 4 sf	1 [1]
<b>Qn 2</b>		<b>Total</b>	<b>14</b>

Question	Sections	Indicative material	Mark
<b>FA 5 is CuSO<sub>4</sub>(aq) + NaNO<sub>2</sub>(aq)</b>			
<b>3 (a)</b>	MMO Collection	Green solution forms blue ppt with NaOH insoluble in excess	1
		(Green solution forms) (pale) blue ppt with NH <sub>3</sub> dissolving in excess to give dark blue solution	1
		(Pale) brown gas evolved <b>or</b> (colourless) gas evolved turning brown in air	1
		Purple solution decolourised	1
		Mixture turns dark blue/black with starch	1 [5]
<b>(b)</b>	MMO Decisions	Selects AgNO <sub>3</sub> <b>and</b> BaCl <sub>2</sub> or Ba(NO <sub>3</sub> ) <sub>2</sub> (or in words)	1
	PDO Layout	Tabulates test and observations (no repeated headings)	1
	MMO Collection	No reaction with AgNO <sub>3</sub> (not just dash)	1
		White ppt with BaCl <sub>2</sub> or Ba(NO <sub>3</sub> ) <sub>2</sub>	1 [4]
<b>(c)</b>	ACE Conclusions	Identifies <b>three</b> ions: cation, Cu <sup>2+</sup> <b>and</b> anions, SO <sub>4</sub> <sup>2-</sup> and NO <sub>2</sub> <sup>-</sup> (one cation <b>and</b> one anion correct = 1 mark)	2
	ACE Interpretation	Cu <sup>2+</sup> from blue ppt with both NaOH and NH <sub>3</sub> <b>or</b> blue ppt with NH <sub>3</sub> forming deep blue solution with excess NH <sub>3</sub>  SO <sub>4</sub> <sup>2-</sup> from white ppt with BaCl <sub>2</sub> or Ba(NO <sub>3</sub> ) <sub>2</sub> <b>or</b> NO <sub>2</sub> <sup>-</sup> from brown gas forming with acid (allow from slight effervescence with acid)	1  1 [4]
<b>Qn 3</b>		<b>Total</b>	<b>13</b>