Cambridge International AS & A Level

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CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills **March 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)	**M1** unambiguous recording of volume of oxygen gas with unit	**1**
	M2 volume of gas within 10% of the supervisor's value	**1**
1(b)(i)	correctly calculates **V(a)** ÷ 150 to 2–4 sig. fig.	**1**
1(b)(ii)	correctly calculates $\frac{\mathbf{V(a)}}{24.0 \times 1000}$ to 2–4 sig. fig.	**1**
1(b)(iii)	correctly uses **(ii)** × 2 **AND** answer to 2–4 sig. fig.	**1**
1(b)(iv)	shows working $\frac{(\mathbf{iii}) \times 1000}{150}$ **AND** answer to 2–4 sig. fig.	**1**
1(c)(i)	MnO_2 in (ignition) tube / floating in weighing boat **OR** use a dropping funnel / syringe for H_2O_2 **AND** subtract the liquid volume	**1**
1(c)(ii)	**M1** $\frac{0.5 \times 100}{50}$ = 1.0%	**1**
	M2 × 3 = 3.0% (3.0 with no working shown scores [2].)	**1**
1(c)(iii)	(agree as) two readings to find volume of gas evolved are needed so there is twice the percentage error in the gas volume reading	**1**
1(d)	no change because MnO_2 / **FA 2** / solid is a catalyst	**1**

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Question	Answer	Marks
2(a)	**I** initial and final burette readings and volume added recorded for rough titre **AND** accurate titre details tabulated	**1**
	II initial and final burette readings recorded and volume of **FA 3** added recorded for each accurate titration • all headings and units correct for accurate titrations – initial / final (burette) reading / volume **OR** reading / volume at start / finish – titre **OR** volume **FA 3** added / used – (cm^3) **OR** / cm^3 **OR** in cm^3 by every entry	**1**
	III all accurate burette readings are recorded to the nearest 0.05 cm^3	**1**
	IV final titre within 0.10 cm^3 of any previous accurate titre	**1**
	V, VI and **VII** award **V**, **VI** and **VII** for $\delta \leqslant 0.20\,cm^3$ award **V** and **VI** for $0.20\,cm^3 < \delta \leqslant 0.30\,cm^3$ award **V** for $0.30\,cm^3 < \delta \leqslant 0.50\,cm^3$	**3**
2(b)	mean titre correctly calculated from clearly selected values: • candidate must average two (or more) titres where the **total** spread is $\leqslant 0.20\,cm^3$ • working must be shown or ticks must be put next to the two (or more) accurate readings selected • the mean should normally be quoted to 2 d.p. rounded to the nearest 0.01 *Note: 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.*	**1**
2(c)	**M1** correctly calculates $\frac{0.030 \times (\mathbf{b})}{1000}$	**1**
	M2 correctly uses **(i)** × 5/2	**1**
	M3 correctly uses **(ii)** × 1000/25	**1**
	M4 all final answers to 3 or 4 sig. fig. (minimum two parts attempted)	**1**

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Question	Answer	Marks
	FA 5 is $C_6H_{12}O_6(aq)$; **FA 6** is $(NH_4)_2Fe(SO_4)_2(aq)$; **FA 7** is $NaNO_2(aq)$	
3(a)(i)–(iv)	see below	**11**

test	**FA 5**	**FA 6**	**FA 7**
(i) aqueous sodium hydroxide, then	no reaction / no ppt. **AND**	green ppt. **AND** insol in excess / turning brown **1**	no reaction / no change / no ppt. **AND**
warm gently	solution turns yellow / yellow-brown / brown **1**	gas / NH_3 turns (damp red) litmus (paper) blue **1**	no reaction / solution remains colourless **1**
aluminium foil and warm	effervescence with **FA 5 or FA 7**	**AND**	gas / NH_3 turns (damp red) litmus (paper) blue **1**
(ii) acidified aqueous potassium manganate (VII)	no reaction **AND**	purple decolourises / solution turns yellow **AND**	purple decolourises / turns colourless **1**
warm gently	purple decolourises / turns colourless **1**		
(iii) hydrogen peroxide		solution turns yellow / effervescence **AND**	no reaction / no change **1**
		gas relights glowing splint **1**	
(iv) hydrochloric acid, then		no reaction / no change / no ppt.	brown gas / colourless bubbles / gas turning brown in air / blue solution
Ba^{2+} (aq)		**AND** white ppt. **1**	**AND** no reaction **1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>
<table>
<tr><th></th><th>cation(s)</th><th>anion(s)</th></tr>
<tr><td>FA 5</td><td>unknown</td><td>unknown</td></tr>
<tr><td>FA 6</td><td>Fe^{2+} / iron(II) and NH_4^+ / ammonium</td><td>SO_4^{2-} / sulfate</td></tr>
<tr><td>FA 7</td><td>unknown</td><td>NO_2^- / nitrite</td></tr>
</table>
</td><td>3</td></tr>
<tr><td rowspan="2">3(b)(ii)</td><td>clearly shows the reagent and expected observation(s)</td><td>1</td></tr>
<tr><td>add NH_3 AND green ppt. AND insoluble in an excess of ammonia / turning brown (on standing)</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>$Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$
OR
$[Fe(H_2O)_6]^{2+}(aq) + 2NH_3(aq) \rightarrow [Fe(OH)_2(H_2O)_4](s) + 2NH_4^+(aq)$</td><td>1</td></tr>
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