Cambridge International AS & A Level

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CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)	**I** Correct headings and units for mass of **FA 1 and** volume of CO_2 • Mass of container + **FA 1** • Mass of container (+ residue) • Mass of **FA 1** • Volume of gas Allow vol for volume but not V Units needed for **all** readings **II** Both weighings to the same number of dp **and** correct mass of **FA 1** calculated (If initial and final volumes recorded then subtraction for volume collected must be correct.)	1 1 **2**
1(b)(i)	Correctly calculates $\frac{V(\mathbf{a})}{24.0 \times 1000}$	1
1(b)(ii)	Correct expression **(i)** × 100.1 **or (i)** × (40.1 + 12 + (3)16) Must show working	1
1(b)(iii)	Correctly uses $\frac{(\mathbf{ii}) \text{x} 100}{\text{mass in} (\mathbf{a})}$	1
	All three answers to 2 to 4 sf	1 **4**
1(c)	Any of: warm water in tub / saturate water with CO_2 / a specific method of separation of $CaCO_3$ and acid so only mixed after bung inserted / gas syringe	1 **1**
	Total	**7**

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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. [minimum 2 × 2 'boxes' with relevant information]	1
	II Initial and final burette readings recorded and volume of **FA 3** added recorded for each accurate titration. Headings and units correct for accurate titrations Headings: initial / final (burette) reading / volume **or** reading / volume at start / finish **and** volume / **FA 3** added / used **or** titre [**not** difference/total] allow vol but not V **and** Units: (cm^3) **or** / cm^3 **or** in cm^3 [or cm^3 by every entry]	1
	III All accurate burette readings are recorded to the nearest 0.05 cm^3 Do **not** award this mark if: 50(.00) is used as an initial burette reading; more than one final burette reading is 50(.00); any burette reading is greater than 50(.0)	1
	IV Final uncorrected titre is within 0.10 cm^3 of any previous uncorrected accurate titre. *Do not include a reading if it is labelled rough.* *Do not award the mark if any accurate burette readings (apart from the initial zero) are given as integers.*	1

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Question	Answer	Marks
	V, VI and **VII** Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the 'best' accurate titres using the hierarchy: identical titres; titres within 0.05 cm^3; titres within 0.1 cm^3; etc., to calculate mean correct to 0.01 cm^3. Examiner uses the best titre to calculate the ratio of acid remaining after reaction with calcium carbonate in Question 1 to this best titre from Question 2 for Supervisor and each candidate. The ratio of this value for the candidate is compared to the ratio of this value for the Supervisor and marks awarded as follows. Award **V**, **VI** and **VII** for 0.95 – 1.05 Award **V** and **VI** for 0.90 – 1.10 Award **V** for 0.80 – 1.20	3 **7**

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Question	Answer	Marks
2(b)	Check mean titre is correctly calculated from clearly selected values (ticks or working). • 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 dp rounded to the nearest 0.01. [e.g. *26.667 must be rounded to 26.67*] Two special cases where the mean may not be to 2 dp: allow mean to 3 dp only for 0.025 or 0.075, e.g. 26.325; allow mean to 1 dp if **all** accurate burette readings were given to 1 dp and the mean is exactly correct. [e.g. *26.0 and 26.2 = 26.1 is correct* *but 26.0 and 26.1 = 26.1 is incorrect*.] Do **not** award this mark if: • the rough titre was used to calculate the mean; • candidate carried out only 1 accurate titration; • burette readings were incorrectly subtracted to obtain any of the accurate titre values; • **all** burette readings (resulting in titre values used in calculation of mean) are integers. *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 **1**
2(c)(i) and (ii)	Correctly calculates $\frac{0.140 \times (\mathbf{b})}{1000}$ **and** same answer in **(ii)** **and** both answers to 3 or 4 sf	1
2(c)(iii) and 2(c)(iv)	Correctly uses **(ii)** $\times$ 10 **and** Answer = 5.(00) $\times 10^{-2}$	1
2(c)(v)	Correctly calculates **(iv)** – **(iii)**	1
2(c)(vi)	Correctly uses [**(v)** $\times$ 100.1]/2	1

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Question	Answer	Marks
2(c)(vii)	Correctly uses [**(vi)** × 100)/(mass in **(a)**] to a minimum of 2 sf	1 **5**
2(d)	Question 1: % purity lower as loss of gas means fewer moles / less mass **$CaCO_3$** Question 2: no change / % same as same amount of **acid** reacts / (amount) **acid** left is same	1 1 1 1 **4 max 3**
	Total	**16**

Question	Answer	Marks
	FA 5 is $NaNO_3$(s); **FA 6** is $CuCO_3$(s); **FA 7** is NaBr(aq)	
3(a)(i)	<table><tr><th>FA 5</th><th>FA 6</th></tr><tr><td>(goes to) colourless or yellow liquid/ solution</td><td>(green) powder / solid (turns) black / black residue</td></tr><tr><td>gas relights glowing splint</td><td>**or gas** turns limewater milky / cloudy white / chalky / forms white ppt</td></tr><tr><td>gas (turns) brown / brown gas **or** solution turns blue</td><td>(pale) blue solution / liquid formed</td></tr></table>	1+1 1 1+1

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Question	Answer	Marks
3(a)(ii)–(iv)	<table><tr><th>FA 5</th><th>FA 6</th></tr><tr><td>**(iii)** solid dissolves / colourless solution allow no reaction / no change / no effervescence</td><td>effervescence / fizzing / bubbling **and** blue solution / liquid formed</td></tr><tr><td>**(iv)** no reaction / no change / no ppt / remains colourless</td><td>blue ppt **and** insoluble in excess</td></tr><tr><td>**(v)** no reaction / no change / no ppt / remains colourless</td><td>(pale) blue ppt **and** soluble in excess to give deep / dark blue (solution)</td></tr></table>	1 1 1
3(a)(v)	**FA 5**: cation unknown; anion nitrate / NO_3^- **FA 6**: cation Cu^{2+} / copper(II); anion carbonate / CO_3^{2-} 4 correct = 3 marks 3 correct = 2 marks 2 correct = 1 mark	1 1 1
3(a)(vi)	$CuCO_3(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l) + CO_2(g)$	1 **12**
3(b)(i)	Selects $AgNO_3$ **and** NH_3 Selects NaOH **and** A*l* **and** HC*l* / HNO_3 / H_2SO_4	1 1
3(b)(ii)	Clearly defined test **|** observation **|** conclusion sections **FA 7** + $AgNO_3$ cream ppt partially soluble in NH_3 **FA 7** is bromide / Br^- from cream ppt	1 1 1 **5**
	Total	**17**

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