Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/31**

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

MARK SCHEME

Maximum Mark: 40

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 will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2016 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

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**

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

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**

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

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

Question	Answer	Marks
3(a)(ii)–(iv)	**FA 5** / **FA 6** **(iii)** solid dissolves / colourless solution allow no reaction / no change / no effervescence / effervescence / fizzing / bubbling **and** blue solution / liquid formed **(iv)** no reaction / no change / no ppt / remains colourless / blue ppt **and** insoluble in excess **(v)** no reaction / no change / no ppt / remains colourless / (pale) blue ppt **and** soluble in excess to give deep / dark blue (solution)	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** Al **and** HCl / 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**