Cambridge International AS & A Level

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CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **May/June 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.

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Question	Indicative material	Mark	Total
1 (a)	**I** Six identifiable masses recorded	1	
	II All recorded masses have unambiguous headings **and** unit: / g **or** (g) **or** g (for each heading) by each entry.	1	
	III Four measured masses all recorded to the same number of decimal places *minimum 1 decimal place*	1	
	IV Correctly calculates mass of **FA1** added **and** mass of CO_2 evolved.	1	
	V, VI and **VII** Examiner compares corrected mass of **FA1** / corrected mass of CO_2 with supervisor value. Accuracy marks are awarded as shown. Award **V**, **VI** and **VII** if $\delta \leqslant 0.10$ Award **V** and **VI** if $0.10 < \delta \leqslant 0.20$ Award **V** if $0.20 < \delta \leqslant 0.40$	3	[7]
(b) (i)	**I** Correctly calculates n(CO_2) (mass CO_2 / 44)	1	
(ii)	**II** Correct equation **and** all state symbols **X**CO_3(s) + 2H$C\mathit{l}$(aq) → **X**$C\mathit{l}_2$(aq) + H_2O(l) + CO_2(g)	1	
(iii) (iv)	**III (iii)** = **(i)** **and** Expression mass of **FA1** / **(iii)** shown in **(iv)**	1	
(iv)	**IV** Correctly uses 60 and the M_r to calculate A_r of **X** (mass of **FA1** / **(iii)** – 60)	1	
	V Identifies **X** as Group 2 metal or ion with nearest A_r value (must have some working for A_r used). Be 9.0, Mg 24.3, Ca 40.1, Sr 87.6, Ba 137.3	1	[5]
(c) (i)	Apparently more moles of CO_2 (lost) so A_r of **X** is smaller. **or** Apparently more moles of **X**CO_3 (used) so A_r of **X** is smaller.	1	
(ii)	Any 2 from: • Small loss in mass • not much difference to A_r so does not cause confusion in identity / still closest to identity of **X**	1	

Question	Indicative material	Mark	Total
(iii)	Any 1 from • Add slowly / add a little at a time • Use a taller beaker (accept larger beaker) / use a conical flask • Use less solid • Use less concentrated acid • Use lumps of solid • Use cotton wool plug • Use a lower temperature	1	[3]
Question 1			**[15]**
2 (a)	**I** Initial and final readings and titre value for rough titre **and** initial and final reading for **two** (or more) accurate titrations	1	
	II Titre values recorded for accurate titrations **and** Appropriate headings for the **accurate** titration table **and** cm^3 units. • initial / start burette reading / volume / value • final / end burette and reading / volume / value • titre **or** volume / **FA4 and** used / added • unit: / cm^3 **or** (cm^3) **or** in cm^3 **or** cm^3 (for each heading)	1	
	III All **accurate** burette readings are recorded to 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.(00)* • *there is only one accurate titration*	1	
	IV There are two uncorrected, **accurate** titres within 0.10 cm^3 • *Do **not** award this mark if, having performed two titres within 0.1 cm^3, a further titration is performed which is more than 0.10 cm^3 from the closer of the two initial titres, **unless** a further titration, within 0.10 cm^3 of any other, has also been carried out.* • *Do **not** award the mark if any "accurate" burette readings (apart from initial 0 cm^3) are given to **zero** dp*	1	[4]

Question	Indicative material	Mark	Total
(b)	Candidate must take the average of two (or more) titres that are within a total spread of not more than 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 be quoted to **2 dp**, rounded to the nearest 0.01. Two special cases where the mean may not be to 2 dp: • Allow mean expressed to 3 dp **only** for 0.025 or 0.075 (e.g. 26.325) • Allow mean if expressed 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 allowed)* *(e.g. 26.0 and 26.1 = 26.1 is incorrect – should be 26.05.)* ***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]
(c) (i)	**I** Correctly calculates n(NaOH) = 0.001	1	
(ii)	**II** Shows use of $\frac{250(\mathbf{c})(\mathbf{i})}{(\mathbf{b})}$	1	
(iii)	**III** Correctly calculates 2 × **1(b)(i)**	1	
(iv)	**IV** Shows use of **2(c)(ii)** + **2(c)(iii)** either as expression **or** correct calculation	1	
	V Shows use of / 0.025(0) **or** × 40 **or** × 1000 / 25	1	[5]
(d) (i)	States that the measuring cylinder / volume of **FA2** has the greatest error **and** should be replaced by burette or pipette	1	
(ii)	Student is correct / greater volume HC*l* used **and** greater mass would react with more HC*l* / would leave less HC*l* unreacted	1	[2]
Question 2			**[12]**

Question	Indicative material	Mark	Total
	FA5 is $MnSO_4$ and NH_4Cl; **FA6** is propanone; **FA7** is propanal;		
3 (a) (i)	Red litmus turns blue (then red)	1	
	Condensation or sublimation / white smoke / white fumes	1	[2]
(a) (ii) and **(b) (i)**	NH_4^+ / ammonium in **3(a)(ii) and** Mn^{2+} / manganese(II) in **3(b)(i)**.	1	
(b) (i)	Selects NaOH and NH_3	1	
	Off-white / beige / light brown precipitate with both NaOH **and** NH_3	1	
	Both precipitates turns brown / darkens	1	
(ii)	white precipitate **and** insoluble in acid	1	
(iii)	Selects $AgNO_3$ / silver nitrate **and** NH_3 / ammonia	1	
	White precipitate **and** insoluble / partially soluble in ammonia	1	
	Cannot see if precipitate dissolves in ammonia / Mn^{2+} causes (off-white) precipitate (so cannot be used to distinguish between halides).	1	[8]
(c)	$MnCl_2$ **and** $(NH_4)_2SO_4$ **or** $MnSO_4$ **and** NH_4Cl	1	[1]
(d)	**Both observations required** **FA6** no reaction / solution turns pink **and** **FA7** turns colourless / decolourises the $KMnO_4$	1	
	FA6 is either 2-methylpropan-2-ol **or** propanone as they cannot be oxidised (only 1 needed) **and** **FA7** is propanal as it can be oxidised.	1	[2]
Question 3			**[13]**