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

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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$C\ell$(aq) → **X**$C\ell_2$(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	

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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]

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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]**

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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]**

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