Cambridge International AS & A Level

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Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/32**

Paper 3 Advanced Practical Skills 2 **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.

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Question	Indicative material	Mark	Total
1 (a)	**I** Appropriate headings **and** units for • mass of **FB 1** • initial and final volumes (of gas). • unit: / g, (g), in g and allow grams / grammes for g **and** / cm^3, (cm^3), in cm^3 or cm^3 (for each heading)	1	
	II Award if candidate volume within appropriate range derived from Supervisor value	1	[2]
(b) (i)	Correctly calculates $\frac{V(\mathbf{a})}{24.0 \times 1000}$	1	
(ii)	Correct expression $\frac{\text{mass Mg in } (\mathbf{a})}{(\text{b})(\text{i})}$	1	
	Both answers in **(b)** to 2 to 4 significant figures	1	[3]
Question 1			**[5]**

2 (a)	**I** Initial and final readings **and** titre value given for rough titre **and** initial and final readings for two (or more) accurate titrations *(minimum of 2 x 2 box)*	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 / **FA3 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 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(.00)*	1	
	IV There are two (or more) 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	
	V, VI and **VII** Examiner rounds any accurate burette to the nearest 0.05 cm^3, checks subtractions and then select the **'best' titres** using the hierarchy: • two (or more) accurate identical titres, *then* • two (or more) accurate titres within 0.05 cm^3, *then* • two (or more) accurate titres within 0.10 cm^3, *etc.* These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm^3. Accuracy marks are awarded as shown. Award **V**, **VI** and **VII** for $\delta \leqslant 0.30$ (cm^3) Award **V** and **VI** for $0.30\,cm^3 < \delta \leqslant 0.60$ (cm^3) Award **V** for $0.60\,cm^3 < \delta \leqslant 1.00$ (cm^3)	3	[7]

(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)	Correctly calculates n(NaOH) $\frac{0.150 \times (\mathbf{b})}{1000}$	1	
(ii) **(iii)**	Correctly uses **(i)** / 2 **and** **(ii)** × 10	1	
(iv)	Correctly calculates 1.00 × 25.0 / 1000 = 0.025(0)	1	
(v)	Correctly uses **(c)(iv)** – **(c)(iii)**	1	
(vi)	Correctly uses $\frac{\text{mass Mg in } 1(\mathbf{a})}{(\mathbf{v})}$	1	
	All final answers to 3 or 4 significant figures (minimum of four parts must be attempted)	1	[6]

(d) (i)	(Experiment 1 is less accurate) One set of: Inaccuracy Improvement Inaccuracy • gas escaped before bung inserted Improvement • viable means of keeping solid and acid separate before being added (not put on lid faster) e.g. use divided flask • use more (excess) of a lower concentration of acid Inaccuracy • balance imprecise / inaccurate balance Improvement • use a balance calibrated to more decimal places (owtte) Inaccuracy • If candidate volume greater than 250 cm^3 then allow problem of measuring volume of gas Improvement • use larger (capacity) measuring cylinder • use less / smaller mass Mg	 1 1	
(ii)	Correct expression or correctly calculates $\frac{24.3 - 20.8}{24.3}$ = 14.4%	1	[3]
Question 2			**[17]**

FB 5 is Al(s); **FB 6** is $NaNO_3$(s); **FB 7** is A$l_2(SO_4)_3$(aq); **FB 8** is MnCl_2(aq);			
3 (a) (i)	**FB 5** + HCl: effervescence / fizzing / bubbling gas pops with **lighted** splint	 1 1	
	FB 5 + **FB 6** + NaOH: vigorous / violent / exothermic / great / extreme / lots of **and** effervescence / fizzing / bubbling **gas** / NH_3 turns (damp) red litmus (paper) blue	 1 1	
	FB 6 + HCl: no reaction / no change / no gas / no ppt **and** **FB 6** +NaOH: no reaction / no change / no ppt	1	
(ii)	**FB 5** is Al (allow Zn) **and** Reason: effervescence / gives H_2 / NH_3 in test 1 and / or 2	1	
	FB 6 cation unknown **or** Ba^{2+} **or** NH_4^+ **or** any group 1 metal **and** reason: from no reaction with NaOH	1	
	anion: NO_3^- / NO_2^- (or both) reason: If NO_3^- then NH_3 with NaOH + Al **and** no reaction with HCl	 1 1	[9]
(b) (i)	Clearly laid out test / observation / conclusion sections Layout has to show clearly where two reagents are used as part of the same test.	1	
	BaCl_2 / $Ba(NO_3)_2$ **and** HCl / HNO_3 $AgNO_3$ and NH_3	 1 1	
	FB 7 only + Ba^{2+} white precipitate **and** insoluble in HCl or HNO_3	1	
	FB 8 only + Ag^+ white precipitate	1	
	FB 7 = sulfate / SO_4^{2-} (allow from white precipitate with Ba^{2+}) **FB 8** = chloride / Cl^- (allow from white precipitate with Ag^+)	 1 1	

(ii)	Off-white / light / pale brown / buff / beige precipitate **and** darkening on standing with **FB 8** Ignore observation with **FB 7**	1	
	FB 8 = Mn^{2+} / manganese(II) from some correct evidence	1	[9]
Question 3			**[18]**