Cambridge International AS & A Level

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CHEMISTRY **9701/32**

Paper 3 Advanced Practical Skills 2 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

Published

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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 $\frac{\text{mass Mg in } (\mathbf{a})}{(b)(i)}$	1	
	Both answers in **(b)** to 2 to 4 significant figures	1	[3]
Question 1			**[5]**

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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]

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(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]

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(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]**

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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	

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(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]**

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