

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

**MARK SCHEME for the October/November 2009 question paper  
for the guidance of teachers**

**9701 CHEMISTRY**

**9701/34**

Paper 34 (Advanced Practical Skills), maximum raw mark 40

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.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper 1
	GCE A/AS LEVEL – October/November 2009	9701	034

Question	Sections	Indicative material	Mark	
1	(a)	PDO Layout MMO Collection Three weighings recorded unambiguously Mass used between 2.50 g and 2.70 g (for all experiments; checked by examiner) Mass decreases after heating in a single experiment (ignore heating to constant mass)	1 1 1	[3]
	(b)	ACE Interpretation Correct subtraction from experimental results in (a) for mass of water lost <b>and</b> for mass of residue (Correct for any experiment or for average)	1	[1]
	(c)	PDO Display Shows working using values in (b) (can be ecf): $\frac{\text{mass of salt}}{159.6}$ and $\frac{\text{mass of water}}{18}$ (or candidate's values for $M_r$ ) Correct calculation of each value and must have between 2 and 4 sf and correct rounding (NO ecf from incorrect $M_r$ )	1 1	[2]
	(d)	ACE Interpretation PDO Display Values from (c) shown in correct calculation or ratio <b>or</b> correct evaluation from calculation (no calculation or ratio) showing dp <b>and correct rounding for dp shown</b> Value of <b>x</b> given as an integer allow 0.5 to go up or down. (Ecf allowed) Correct answer alone (integer) and no expression or calculation shown can only gain the second mark.	1 1	[2]
	(e)	PDO Layout PDO Recording MMO Decisions MMO Quality (i) Tabulates minimum of the burette readings or minimum of two titres (lines not needed) (ii) Records initial and final burette readings and volume of <b>FB 3</b> run from burette (Don't award if readings inverted or final is 50, 50.0 or 50.00 more than once) (iii) Appropriate headings and units for data given. ( <i>Only acceptable headings: initial/final or 1<sup>st</sup>/2<sup>nd</sup> (burette) reading; reading at start/finish; volume added; volume used; titre. Only acceptable presentation of units is solidus /cm<sup>3</sup>; brackets (cm<sup>3</sup>) or "volume in cubic centimetres" or "volume in cm<sup>3</sup>"</i> ) If units not included with heading, every entry in table must have a correct unit. (iv) All burette readings other than that labelled "rough" recorded consistently to nearest .05cm <sup>3</sup> (v) Two uncorrected titres within 0.1 cm <sup>3</sup> (can include rough) (vi), (vii), (viii) and (ix) Check and correct titre subtractions where necessary. Examiner selects the best mean titre (treat as accurate unless labelled "rough" or to fewer dp) and compares to Supervisor: <i>Apply a hierarchy: 2 identical, titres within 0.05 cm<sup>3</sup>, titres within 0.10 cm<sup>3</sup> etc.</i> Award (vi), (vii), (viii) and (ix) for: a titre within 0.20 cm <sup>3</sup>	1 1 1 1 4	

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper 1
	GCE A/AS LEVEL – October/November 2009	9701	034Based.com

Question	Sections	Indicative material	Mark	
	MMO Decisions  PDO Display	<p>Award <b>(vi)</b>, <b>(vii)</b>, <b>(viii)</b> <b>only</b> for: a titre of 0.20+ cm<sup>3</sup> to 0.30 cm<sup>3</sup></p> <p>Award <b>(vi)</b> and <b>(vii)</b>, <b>only</b> for: a titre of 0.30+ cm<sup>3</sup> to 0.50 cm<sup>3</sup></p> <p>Award <b>(vi)</b> <b>only</b> for: a titre of 0.50+ cm<sup>3</sup> to 0.80 cm<sup>3</sup></p> <p>Apply spread penalty as follows: titres selected (by examiner) differ &gt; 0.20 cm<sup>3</sup> but ≤ 0.50 cm<sup>3</sup> = -1; titres &gt; 0.50 cm<sup>3</sup> = -2 from marks awarded in <b>(vi)</b> to <b>(ix)</b> (no negative marks)</p> <p>Apply a spread of -2 if only one titration is performed or single value selected.</p> <p><b>(x)</b> Selects (and ticks – but some indication must be shown) at least two titres for calculation of mean titre, all titres used to be within 0.2 cm<sup>3</sup></p> <p><b>(xi)</b> Correct mean displayed to same number of decimal places as most precise burette reading (If initial reading 0 use to dp of final) (If titres 0.05 apart then 0.025 or 0.075 is acceptable)</p>	1  1	[11]
<b>(f)</b>	ACE Interpretation	<p><b>(i)</b> Systematic error, non-consistent zero or wtte or different precision of balance (just!)</p> <p><b>(ii)</b> Correct calculation of maximum % error (<sup>0.5</sup>/<sub>10</sub> × 100 =) 5%</p>	1  1	[2]
<b>(g)</b>	ACE Conclusions	<p>(Mass loss is too low) Candidate suggests</p> <p><b>(i)</b> insufficient heating <b>or</b> <b>(ii)</b> solid reabsorbs moisture on cooling</p>	1	[1]
<b>(h)</b>	ACE Improvement	<p><b>(i)</b> Heating to constant mass (could be in explanation, possible ecf from <b>(g)</b>)</p> <p><b>Or</b></p> <p><b>(ii)</b> Cooling in desiccator / cooling with lid on crucible <b>or</b> <b>(iii)</b> Grinding/crushing before heating provided candidate makes clear that not all water driven off (as not heated long enough)</p> <p><u>Explains</u> that mass loss or wtte is too low and how modification will reduce this <i>Reference to mass loss being too low may be in <b>(g)</b>.</i></p>	1  1	[2]
<b>Qn 1</b>	<b>Total</b>			<b>[24]</b>
<b>FB 6 is MgCl<sub>2</sub>(aq); FB 7 is Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (aq); FB 8 is CaCl<sub>2</sub></b>				

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper 1
	GCE A/AS LEVEL – October/November 2009	9701	034Based.com

Question	Sections	Indicative material	Mark	
2 (a)	MMO Collection	(i) <b>For FB 6</b> NaOH – a white ppt* insoluble in excess NH <sub>3</sub> (aq) – white ppt insoluble in excess	1	
		(ii) <b>For FB 7</b> NaOH – a white ppt soluble in excess NH <sub>3</sub> (aq) – white ppt insoluble in excess	1	
		(iii) <b>For FB 8</b> NaOH – a white ppt insoluble in excess NH <sub>3</sub> (aq) – no precipitate	1	
	ACE Conclusions	(iv) <b>FB 7</b> contains Al <sup>3+</sup>	1	
		(v) <b>FB 6</b> contains Mg <sup>2+</sup>	1	
		(vi) <b>FB 8</b> contains Ca <sup>2+</sup> ecf only for these ions and from white ppts only (iv), (v), (vi) cannot be awarded if any of the relevant observations are incorrect	1	
	ACE Interpretation	(vii) Gives appropriate evidence for identification of at least two ions (any 2). Minimum statement required: Al <sup>3+</sup> – (white) ppt soluble in excess NaOH; Mg <sup>2+</sup> – (white) ppt insoluble in excess NaOH and (white) ppt with NH <sub>3</sub> ; Ca <sup>2+</sup> – no ppt with NH <sub>3</sub> . No colour ppt other than white but colour of ppt may be taken from observations	1	[7]
(b)	MMO Decisions	Add (aqueous) barium chloride** (nitrate) <b>and</b> three correct observations	1	
	MMO Collection	Any white precipitate (from above) insoluble in HCl or HNO <sub>3</sub> (Acid name may be in 1 <sup>st</sup> part of answer)	1	[2]
<b>Qn 2</b>	<b>Total</b>			<b>[9]</b>

\*solid (formed)

\*\*Ba<sup>2+</sup><sub>(aq)</sub> or aqueous barium ions

FB 9 is NaNO<sub>3</sub>

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper 1
	GCE A/AS LEVEL – October/November 2009	9701	034Based.com

Question	Sections	Indicative material	Mark	
<b>3 (a)</b>	MMO Collection	Gas evolved relights a glowing splint in test <b>(i)</b>	1	[4]
		No reaction/no gas given off in test/only (see) solid dissolving <b>(ii)</b>	1	
	ACE Conclusion	<u>Gas</u> turning red litmus blue evolved on heating with NaOH and Aluminium foil in test <b>(iii)</b>	1	
		Oxygen evolved or NO <sub>2</sub> evolved from brown gas in <b>(i)</b> <b>and</b> ammonia gas evolved in <b>(iii)</b> based on correct observations (no ecf)	1	
<b>(b)</b>	ACE Conclusions	Nitrogen <b>and</b> oxygen ecf allowed for <b>(i)</b> if also hydrogen from "pops with lighted splint"	1	[1]
<b>(c)</b>	ACE Conclusions	States that aluminium foil is a reductant/reducing agent	1	[1]
<b>(d)</b>	MMO Decisions	No reaction if nitrate Colourless gas, turning brown in air or brown gas if nitrite Link back to <b>(b)</b> if single ion given (e.g. if only NO <sub>3</sub> <sup>-</sup> in <b>(b)</b> then give mark for "no reaction")	1	[1]
<b>Qn 3</b>	<b>Total</b>			<b>[7]</b>