

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
GCE Advanced Subsidiary Level and GCE Advanced Level

## **MARK SCHEME for the May/June 2013 series**

### **9701 CHEMISTRY**

**9701/33**

Paper 33 (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.

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.

Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

|        |                                |          |         |
|--------|--------------------------------|----------|---------|
| Page 2 | Mark Scheme                    | Syllabus | Paper 1 |
|        | GCE AS/A LEVEL – May/June 2013 | 9701     |         |

| Question | Sections           | Indicative material                                                                                                                                                                                                                                                               | Mark | Total              |
|----------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|--------------------|
| 1 (a)    | PDO Recording      | Table completed and all temperatures recorded to 0.5°C; must include initial T and at least one of the nine readings must be .5 (others .0) or vice versa.                                                                                                                        | 1    | [2]                |
|          | MMO Decision       | Suitable choice of volumes ( <b>FA 2</b> + water = 35 cm <sup>3</sup> ): one either side of maximum or two between maximum and one of the values differing by 5 cm <sup>3</sup> .<br>If 'max' at 35 then allow 2 between 30 & 35 or allow two volumes > 35. (ignore water volume) | 1    |                    |
| (b) (i)  | PDO Layout         | Scales chosen so that graph occupies more than half the available length for x- and y-axis and axes labelled volume/cm <sup>3</sup> or <b>FA 2</b> /cm <sup>3</sup> and temperature/°C (or brackets).                                                                             | 1    |                    |
|          | PDO Layout         | <b>All</b> points plotted to within half a small square. (6 min)                                                                                                                                                                                                                  | 1    |                    |
| (ii)     | PDO Layout         | Two appropriate/sensible best fit lines drawn – must intersect at or above max temperature.                                                                                                                                                                                       | 1    |                    |
| (iii)    | ACE Interpretation | $\Delta T$ calculated from graph.                                                                                                                                                                                                                                                 | 1    |                    |
|          | MMO Quality        | Award if $\Delta T$ within 1.0°C of Supervisor.                                                                                                                                                                                                                                   | 1    | [5]                |
| (c) (i)  | PDO Display        | Shows $Q = 60 \times 4.3 \times \Delta T$                                                                                                                                                                                                                                         | 1    |                    |
| (ii)     | ACE Interpretation | Moles = $\frac{25 \times 0.950}{1000} = 0.024$ (0.0238 or 0.02375)                                                                                                                                                                                                                | 1    |                    |
| (iii)    | ACE Interpretation | Correctly calculates enthalpy change, including sign, to 2–4 sf<br>= - <b>(c)(i)</b><br>1000 × <b>(c)(ii)</b>                                                                                                                                                                     | 1    | [3]                |
|          |                    |                                                                                                                                                                                                                                                                                   |      | <b>[Total: 10]</b> |

|        |                                |          |         |
|--------|--------------------------------|----------|---------|
| Page 3 | Mark Scheme                    | Syllabus | Paper 1 |
|        | GCE AS/A LEVEL – May/June 2013 | 9701     |         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|
| 2 (a)                                                                                                                                                                                                                                                                                                                                                                                                                                 | PDO Layout     | <b>I</b> Volume given for rough titre <b>and</b> accurate titre details tabulated. (Minimum 2 × 2 boxes)                                                                                                                                                                                                                                                                                                                                                                                    | 1 |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                       | MMO Collection | <b>II</b> Initial and final burette readings recorded for rough titre <b>and</b> volume of <b>FA 4</b> added recorded for each accurate titre. Headings and units correct for accurate titration.                                                                                                                                                                                                                                                                                           | 1 |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                       | PDO Recording  | <b>III</b> All accurate burette readings to 0.05 cm <sup>3</sup> .<br><i>Do <b>not</b> award this mark if:<br/>50(.00) is used as an initial burette reading;<br/>more than one final burette reading is 50(.00);<br/>any burette reading is greater than 50(.0).</i>                                                                                                                                                                                                                       | 1 |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                       | MMO Decisions  | <b>IV</b> Has two uncorrected accurate titres within 0.1 cm <sup>3</sup> .<br>Do not award if, having performed two titres within 0.1 cm <sup>3</sup> , a further titration is performed that is more than 0.1 cm <sup>3</sup> from the closer of the original 2 titres unless a further titration has been carried out which is within 0.1 cm <sup>3</sup> of any others.<br><br>Do not award if titres from burette readings to no dp are used (apart from use of 0 for initial reading). | 1 |     |
| <p>Examiner rounds any accurate burette readings to the nearest 0.05 cm<sup>3</sup>, checks subtractions and then selects the 'best' titres for Supervisor and candidate using the hierarchy:<br/><i>two identical; titres within 0.05 cm<sup>3</sup>; titres within 0.1 cm<sup>3</sup>; etc.</i><br/>to calculate mean correct to 0.01 cm<sup>3</sup>.</p> <p>Examiner compares candidate mean titre with Supervisor mean titre.</p> |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                       | MMO Quality    | <b>V, VI and VII</b><br>Award <b>V, VI</b> and <b>VII</b> for $\delta \leq 0.20 \text{ cm}^3$<br>Award <b>V</b> and <b>VI</b> for $0.20 \text{ cm}^3 < \delta \leq 0.40 \text{ cm}^3$<br>Award <b>V</b> for $0.40 \text{ cm}^3 < \delta \leq 0.60 \text{ cm}^3$<br><i>Apply <b>spread penalty</b> as follows:<br/>If best titres are <math>\geq 0.50 \text{ cm}^3</math> cancel one of the Q marks.</i>                                                                                     | 3 | [7] |

|        |                                |          |         |
|--------|--------------------------------|----------|---------|
| Page 4 | Mark Scheme                    | Syllabus | Paper 1 |
|        | GCE AS/A LEVEL – May/June 2013 | 9701     |         |

|         |                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |     |
|---------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|
| (b)     | ACE Interpretation | <p>Mean titre is correctly calculated from clearly selected values (ticks or working).<br/>Candidate must average two (or more) titres that are within 0.20 cm<sup>3</sup> of each other.<br/>Working must be shown or ticks must be put next to the two (or more) accurate readings selected.<br/><i>The mean should normally be quoted to 2 dp rounded to the nearest 0.01.</i><br/><i>Two special cases where the mean may not be to 2 dp: allow mean to 3 dp only for 0.025 or 0.075 eg 26.325; allow mean to 1 dp if <b>all</b> accurate burette readings were given to 1 dp and the mean is exactly correct. eg 26.0 and 26.2 = 26.1 is correct but 26.0 and 26.1 = 26.1 is incorrect.</i></p> <p><i>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.</i></p> | 1 | [1] |
| (c) (i) | ACE Interpretation | Correctly calculates $\frac{0.095 \times (b)}{1000}$ to 3 or 4 sf.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1 |     |
| (ii)    | ACE Interpretation | Correctly calculates $\frac{(c)(i)}{2}$ to 3 or 4 sf                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |     |
| (iii)   |                    | <p><b>and</b><br/><math>\frac{(c)(ii) \times 1000}{25.0}</math> to 3 or 4 sf (<i>do not penalise sf twice</i>).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1 |     |
| (iv)    | ACE Interpretation | $A_r = \frac{[6.90/(c)(ii)] - 60}{2}$ calculated to 0–2 dp                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 |     |
| (v)     | ACE Conclusion     | Corresponding identity of <b>M</b> (must be Group 1) ( <i>can be from negative number – ignore sign</i> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1 |     |
|         | PDO Display        | Working in the correct direction shown in at least 3 stages in (i), (ii), (iii) and (iv).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 | [5] |

|        |                                |          |         |
|--------|--------------------------------|----------|---------|
| Page 5 | Mark Scheme                    | Syllabus | Paper 1 |
|        | GCE AS/A LEVEL – May/June 2013 | 9701     |         |

|                    |                    |                                                                                                                                                                                                                                                                                                                                                               |   |     |
|--------------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|
| (d) (i)            | ACE Interpretation | (Titration more accurate) because temperature rises are small <b>or</b> titration apparatus/burette/pipette is more accurately calibrated or more precise or lower % error or is more accurate than measuring cylinder ( <i>ora</i> for measuring cylinder) <b>or</b> the indicator gives an exact/precise end point but measuring temperature rise does not. | 1 |     |
| (ii)               | ACE Improvement    | use more volumes near the maximum $\Delta T$ <b>or</b> use burette/pipette <b>or</b> better insulation/use of lid <b>or</b> use more accurately calibrated thermometer <b>or</b> increase concentration(s) <b>or</b> measuring initial $T$ of solutions for each expt carried out                                                                             | 1 | [2] |
| <b>[Total: 15]</b> |                    |                                                                                                                                                                                                                                                                                                                                                               |   |     |

|                                                                                                       |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |  |
|-------------------------------------------------------------------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|--|
| <b>FA 5 is <math>ZnCO_3 + NaBr</math>; FA 6 is <math>NaNO_2</math>; FA 7 is <math>Na_2SO_4</math></b> |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |  |
| 3 (b) (i)                                                                                             | MMO Collection | Effervescence / fizzing / bubbling or gas (evolved) <b>which turns limewater milky.</b>                                                                                                                                                                                                                                                                                                                                                                                                            | 1 |  |
| (ii)                                                                                                  | MMO Collection | White precipitate, dissolves in excess sodium hydroxide.                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1 |  |
|                                                                                                       | ACE Conclusion | $Zn^{2+}$ , $Al^{3+}$ and $Pb^{2+}$ <i>Allow zinc, aluminium, lead</i> no ecf.                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 |  |
| (iii)                                                                                                 | MMO Decisions  | Suitable pair of reagents chosen to distinguish between the 3 expected ions ( $NH_3$ + one other).                                                                                                                                                                                                                                                                                                                                                                                                 | 1 |  |
|                                                                                                       | PDO Display    | Six correct theoretical results for the three ions.<br><i>Allow ‘--’ for no reaction</i><br>Award one mark if one set of theoretical results match the given reagent (ie mark horizontally or vertically)<br><b>ecf possible</b> from observations in (ii) (for 1 mark) as pairs require a single reagent<br>$Mg^{2+}$ and $Ca^{2+}$ <b>if</b> white ppt insoluble in excess in (ii);<br>$Ba^{2+}$ and $NH_4^+$ <b>if</b> no ppt obtained in (ii);<br>two out of the correct three ions are chosen | 1 |  |

|        |                                |          |              |
|--------|--------------------------------|----------|--------------|
| Page 6 | Mark Scheme                    | Syllabus | Paper 1      |
|        | GCE AS/A LEVEL – May/June 2013 | 9701     | 033Based.com |

| reagent                 | Zn <sup>2+</sup>            | Al <sup>3+</sup>          | Pb <sup>2+</sup>          |
|-------------------------|-----------------------------|---------------------------|---------------------------|
| aqueous NH <sub>3</sub> | white ppt soluble in excess | white ppt insol in excess | white ppt insol in excess |
| aqueous KI              | no reaction/sol             | no reaction/sol           | yellow ppt/insol          |
| aq named sulfate        | no reaction/sol             | no reaction/sol           | white ppt/insol           |
| aq named chromate       | no reaction/sol             | no reaction/sol           | yellow ppt/insol          |
| aq named chloride       | no reaction/sol             | no reaction/sol           | white ppt/insol           |

| reagent                                      | Mg <sup>2+</sup>              | Ca <sup>2+</sup>                                    |
|----------------------------------------------|-------------------------------|-----------------------------------------------------|
| aqueous NH <sub>3</sub>                      | white ppt insoluble in excess | no ppt                                              |
| allow aq named SO <sub>4</sub> <sup>2-</sup> | no reaction                   | white ppt                                           |
| reagent                                      | Ba <sup>2+</sup>              | NH <sub>4</sub> <sup>+</sup>                        |
| aq NaOH + heat                               | no reaction                   | NH <sub>3</sub> given off/gas turns red litmus blue |
| or aq named SO <sub>4</sub> <sup>2-</sup>    | white ppt                     | no reaction                                         |

|             |                |                                                                                                                                         |   |     |
|-------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------|---|-----|
| (iii) cont. | MMO Collection | Practical results: ( <i>independent of earlier work</i> )<br>White ppt soluble in excess NH <sub>3</sub> (ignore 2nd reagent)           | 1 | [7] |
|             | ACE Conclusion | cation is Zn <sup>2+</sup> /zinc<br>( <i>allow from ppt soluble in excess – no mention of white</i> )                                   | 1 |     |
| (c)         | MMO Collection | Cream ppt with silver nitrate <b>and</b> ppt partially dissolves with ammonia/ insoluble in ammonia/ soluble in conc. NH <sub>3</sub> . | 1 | [2] |
|             | ACE Conclusion | <b>bromide/Br<sup>-</sup></b> ecf from off-white or qualified cream ppt with AgNO <sub>3</sub>                                          | 1 |     |
| (d)         | ACE Conclusion | carbonate/CO <sub>3</sub> <sup>2-</sup> (candidate must have 'gas' in (b)(i))                                                           | 1 | [1] |
| (e) (i)     | MMO Collection | 1 for each correct horizontal row or vertical column                                                                                    | 3 |     |

|        |                                |          |         |
|--------|--------------------------------|----------|---------|
| Page 7 | Mark Scheme                    | Syllabus | Paper 1 |
|        | GCE AS/A LEVEL – May/June 2013 | 9701     |         |

| test             | FA 6                                     | FA 7                                                                                   |
|------------------|------------------------------------------|----------------------------------------------------------------------------------------|
| Al + NaOH        | ammonia/gas turns (damp) red litmus blue | no reaction / dash<br>(ignore gases evolved unless turns red litmus blue or other con) |
| Ba <sup>2+</sup> | no reaction                              | white ppt                                                                              |
| acid             | allow (brown) gas/ effervescence         | ppt insol/no change<br>/ no reaction (not dash)                                        |
| HCl              | brown gas / blue solution                | no reaction / no change / dash                                                         |

|       |                |                                                                                                                                                                                                                                |   |             |
|-------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-------------|
| (ii)  | ACE Conclusion | FA 6 contains NO <sub>2</sub> <sup>-</sup> minimum evidence needed is (brown) gas produced with acid (may be in 2nd or 3rd test)<br>FA 7 contains SO <sub>4</sub> <sup>2-</sup> (from correct obs with Ba <sup>2+</sup> + HCl) | 1 |             |
| (iii) | ACE Conclusion | Redox / oxidation of Al / reduction of N / NO <sub>2</sub> <sup>-</sup> / H / OH <sup>-</sup>                                                                                                                                  | 1 | [5]         |
|       |                |                                                                                                                                                                                                                                |   | [Total: 15] |