**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge International Advanced Subsidiary and Advanced Level**

# MARK SCHEME for the May/June 2015 series

## 9701 CHEMISTRY

**9701/31** Paper 3 (Advanced Practical Skills 1), 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.

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International Examinations

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| 1 (a) | **I** Initial and final burette readings and titre unambiguously recorded in rough and accurate titrations.<br>*Minimum of 2 × 2 boxes for accurate.* | 1 | |
| | **II** Headings and units correct for accurate titration and headings match readings.<br>*Headings: initial / final (burette) reading / volume or Reading / volume / vol / value at start / finish* ***and*** *Volume / vol /* ***FA*** *1 added / used or titre [not "difference or "total"]*<br>***and*** *Units: ($cm^3$) or / $cm^3$ or in $cm^3$ or $cm^3$ by every entry* | 1 | |
| | **III** All accurate burette readings (initial and final) recorded to nearest 0.05 $cm^3$<br>*Do* ***not*** *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.(00)* | 1 | |
| | **IV** Has two uncorrected, accurate titres within 0.1 $cm^3$<br>*Do* ***not*** *award this mark if, having performed two titres within 0.1 $cm^3$, a further titration is performed that is more than 0.1 $cm^3$ from the closer of the two initial titres unless further titrations within 0.1 $cm^3$ of any other has also been carried out.*<br>*Do* ***not*** *award the mark if any 'accurate' burette readings (apart from initial 0) are given to* ***zero*** *dp.* | 1 | |
| Examiner rounds all all burette readings to the nearest 0.05 $cm^3$ and checks subtractions. Examiner selects the 'best' titres using the hierarchy:<br>two (or more) identical,<br>then two (or more) within 0.05 $cm^3$ ,<br>then two (or more) within 0.1 $cm^3$, etc. | | | |

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| | Award **V**, **VI** and **VII** if $\delta \leqslant 0.20\,cm^3$<br>Award **V** and **VI** if $0.20 \leqslant \delta \leqslant 0.40\,cm^3$<br>Award **V** if $0.40 \leqslant \delta \leqslant 0.60\,cm^3$<br><br>*Spread penalty: if the two 'best' titres used by the examiner are more than $0.50\,cm^3$ apart cancel one of the Q marks.* | 1<br>1<br>1 | [7] |
| **(b)** | Calculation of mean<br>Candidate must average two (or more) titres that are **all** within $0.20\,cm^3$.<br>Working must be shown or ticks must be put next to the two (or more) accurate readings selected.<br><br>*The mean should normally be quoted to 2 dp rounded to the nearest 0.01. Example: 26.667 must be rounded to 26.67.*<br>*Two special cases where the mean may not be to 2 dp:*<br>*allow mean to 3 dp only for 0.025 or 0.075, e.g. 26.325;*<br>*allow mean 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 correct but 26.0 and 26.1 = 26.1 is incorrect.* | 1 | [1] |
| **(c)(i)(ii)** | **I** Correctly calculates $\frac{0.0200 \times (b)}{1000}$ in step **(i)**<br>**and**<br>$\times$ 5 in **(ii)** | 1 | |
| **(iii)** | **II** Expression **(ii)** / 0.025 | 1 | |
| **(iv)** | **III** Expression **(iii)** $\times$ 392.0 (or addition of $A_r$s shown) | 1 | |
| | **IV** Answers to **(i)** to **(iv)** given to 3 or 4 sf (min 3 answers needed) | 1 | [4] |
| **Qn 1** | **Total** | **[12]** | |

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| **2 (a)** | **I** Table with unambiguous headings and correct units<br>All readings must be included. | 1 | |
| | **II** All temperatures recorded to .0 or .5 °C. Must include at least one ending in .0 and one ending in .5. | 1 | |
| Examiner calculates candidate's $\Delta T$ max from table. | | | |
| | **III** Award if the difference between candidate and Supervisor is within 4.0 °C | 1 | |
| | **IV** Award if the difference between candidate and Supervisor is within 2.0 °C | 1 | [4] |
| **(b) (i)** | Axes labelled temperature or *T* or °C or temperature and time or minutes or min or t.<br>Linear scales chosen to use more than half of each axis and to include 5 °C more than the maximum temp. | 1 | |
| | All points recorded (minimum of 10). Correct plotting – each point accurately plotted (within ½ small square and in the correct square). | 1 | |
| **(ii)** | All three straight lines drawn | 1 | |
| | Lines of best fit and extrapolated | 1 | |
| **(iii)** | Correct $\Delta T$ from graph to within .2 °C of examiner value using the candidate's lines. | 1 | [5] |

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| **(c) (i)** | Correct answer to 4.2 × 40 × ans**(b)(iii).**<br>Allow answers to 2 –4 sf | 1 | |
| **(ii)** | Correct answer to **(i)** / 219000<br>Allow answers to 2–4 sf | 1 | |
| **(iii)** | Expression **(ii)** / 0.040<br>Allow answers to 2–4 sf | 1 | [3] |
| **(d) (i)** | Correct answer correct to number of sf shown (min 2 sf):<br>0.5 / highest temp × 100 | 1 | |
| **(ii)** | Do not agree as the zinc is in excess | 1 | |
| **(iii)** | Incorrect as temperature rise is the same<br>**or**<br>Incorrect as (a smaller volume) has a greater % error ORA | 1 | [3] |
| **Qn 2** | **Total** | **[15]** | |

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| | **FA 5** is $(NH_4)_2Fe(SO_4)_2(aq)$; **FA 6** is $CuCO_3 + MgSO_4.7H_2O$ | | |
| **3 (a)** | Fizzing | 1 | |
| | Acid or any named acid | 1 | [2] |
| **(b)(i)–(vi)** | In **(i)** (solid goes from green) to black / grey | 1 | |
| | In **(i)** condensation / water / water vapour / steam / steamy fumes | 1 | |
| | In **(ii)** fizzing **and** forms a (light) blue solution . | 1 | |
| | Cloudy with limewater in **(i)** or **(ii)** or **(a)** | 1 | |
| | In **(ii)** blue ppt with sodium hydroxide and insoluble in excess. | 1 | |
| | Any **2** from:<br>In **(iv)** white ppt insoluble in excess | 1 | |
| | In **(v)** white ppt insoluble in excess<br>In **(vi)** white ppt | 1 | |
| **(vii)** | Cation: $Cu^{2+}$ | 1 | |
| | Cation: $Mg^{2+}$ | 1 | |
| | Anions: $CO_3^{2-}$ **and** $SO_4^{2-}$ **and** $SO_3^{2-}$ | 1 | |
| **(viii)** | Selects acid/ named acid to add to test **(vi)** (**not** $H_2SO_4$)<br>**or**<br>Selects named acid to add to **FA 6 and** tests with $H^+/Cr_2O_7^{2-}$ or $H^+/MnO_4^-$<br>**and**<br>$SO_4^{2-}$ insoluble and $SO_3^{2-}$ soluble<br>**or**<br>$SO_4^{2-}$ no change and $SO_3^{2-}$ (orange) turns green or (purple) turns colourless | 1 | [11] |
| **Qn 3** | **Total** | **[13]** | |