**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

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

# MARK SCHEME for the May/June 2011 question paper

# for the guidance of teachers

## 9701 CHEMISTRY

**9701/35** Paper 31 (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.

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UNIVERSITY of CAMBRIDGE
International Examinations

| Question | Sections | Indicative material | Mark | |
|---|---|---|---|---|
| **1 (a)** | PDO layout | **I** Volume given for rough titre **and** accurate titre details tabulated<br>*Minimum of 2×2 "boxes"* | 1 | |
| | MMO collection | **II** Follows instructions – dilutes 44.50–45.50 $cm^3$ **FA 2**<br>**and** records unambiguous initial and final burette readings and volume of **FA 2** diluted and volume of **FA 3** added for each titration.<br>*Headings should match readings.*<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 | |
| | MMO decisions | **III** All accurate burette readings (initial and final) recorded to nearest 0.05 $cm^3$ including dilution table<br>*Assess this mark on burette readings only, ignore volume of **FA 3** added.* | 1 | |
| | PDO recording | **IV** has two titres within 0.10 $cm^3$<br>*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 initial **two** titres, unless a fourth titration, within 0.1 $cm^3$ of any other has also been carried out.* | 1 | |
| | Examiner to check and correct (if necessary) subtractions in the titre table.<br>Examiner then selects the "best" titre using the hierarchy:<br>two identical; titres within 0.05 $cm^3$, titres within 0.10 $cm^3$, etc., (ignore rough titre)<br>For candidates and Supervisor scale titre for 45.00 $cm^3$ **FA 2** diluted.<br>Calculate titre × $^{45.00}/_{\text{volume of FA 2 diluted}}$ to 2 dp<br>Calculate difference in Supervisor and candidate scaled values and award "quality" marks as below. | | | |
| | MMO quality | Award **V**, **VI** and **VII** for a difference from Supervisor, $\delta$ 0.30 $cm^3$ | 1 | |
| | | Award **V** and **VI** for 0.30 < $\delta$ 0.60 $cm^3$ | 1 | |
| | | Award **V** only for 0.60 < $\delta$ 1.00 $cm^3$<br>*If "best" **titres** are 0.60 $cm^3$ apart cancel one of the Q marks* | 1 | [7] |

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| **(b)** | ACE interpretation | Calculates the mean, correct to 2 decimal places from any accurate titres within 0.20 $cm^3$.<br>*The third decimal place may be rounded to the nearest 0.05 $cm^3$.*<br>*A mean of exactly .x25 or .x75 is allowed but the candidate may round up or down to the nearest 0.05 $cm^3$.*<br>*If **ALL** burette readings are given to 1 decimal place then the mean can be given to 1 decimal place* if numerically correct without rounding.<br>*Mean of 24.3 and 24.4 = 24.35 (✓)*<br>*Mean of 24.3 and 24.4 = 24.4 (✗)*<br><br>***Titres to be used in calculating the mean must be clearly shown – in an expression or ticked in the titration table.*** | 1 | [1] |
| **(c)** | ACE interpretation | **I** Expression correct in step **(i)**<br>$^{\text{volume diluted}}/_{250}$ × 1.00 | 1 | |
| | | **II** Correctly uses<br>$^{\text{titre from (b)}}/_{1000}$ × ans to **(i)** in **(ii)**<br>**and** ½ × ans to **(ii)** in **(iii)** | 1 | |
| | | **III** ans to **(iii)** × $^{1000}/_{25}$ × 201.2 in **(iv)** | 1 | |
| | | **IV** Uses $^{(38.10 - \text{ans to (iv)})}/_{38.10}$ × 100 in **(v)** | 1 | |
| | PDO display | **V** Working shown in all steps attempted and a minimum of 3 steps. (use of 2 in **(iii)**, missing × 40 or $M_r$ in **(iv)** gains the mark)<br>*(Working should be a step in the right direction)* | 1 | |
| | | **VI** 3 to 4 significant figures shown in final answer to all steps attempted – minimum of 3 steps | 1 | [6] |
| **(d)** | ACE interpretation | Correctly evaluates:<br>$^{0.06}/_{25}$ × 100 or 0.24 %<br>**and**<br>$^{0.10}/_{\text{titre in (b)}}$ × 100<br>*Answers must be given to at least 2 significant figures and correctly rounded for the significant figures shown.* | 1 | [1] |
| | | | | **[Total: 15]** |

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| **2 (a)** | PDO layout | **I** All data presented clearly in all three sections. (6,6,7) | 1 | |
| | PDO recording | **II** Has correct headings and units on page 7. | 1 | |
| | | **III** All thermometer readings recorded to nearest 0.5 ˚C in each of the experiments | 1 | |
| | | **IV** Each pair of balance readings consistent and to at least 1 decimal place | 1 | [4] |
| **(b)** | Examiner to calculate (corrected) $\Delta T_1/m_1$ and $\Delta T_2/m_2$ for Supervisor and candidate. Compare candidate value with the same value from the Supervisor report. Award Q marks on the closer value. | | | |
| | MMO | Award **I** and **II** for $\delta$ 0.10 °Cg$^{-1}$ | 1 | |
| | quality | Award **I** only for 0.10 < $\delta$ 0.30 °Cg$^{-1}$ | 1 | [2] |
| **(c)** | MMO collection | **I** Follows instructions – weighs between 8.5 and 9.5 g of **FA 6** (mass bottle with **FA 6** – mass bottle) | 1 | |
| | PDO layout | **II** Check $\Delta$m and $\Delta$T are correct in **(c)** | 1 | [2] |
| **(d)** | ACE interpretation | Examiner to check there is no obvious error in the evaluation of the expression, then award **one mark** for a mass of sodium carbonate between 2.5 and 3.5 g. | 1 | [1] |
| **(e)** | ACE improvements | Give **one mark** for:<br>suggesting weighing, heating and weighing again,<br>**or**<br>weighing, heating and measuring gas volume<br>**or**<br>giving an outline for a titration method using 2 indicators. | 1 | [1] |
| | | | | **[Total: 10]** |

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| **FA 8** is NaC*l*(aq); **FA 9** is $NaNO_2$(aq); **FA 10** is NaBr(aq); **FA 11** is $CuSO_4$(aq); **FA 12** is $MgSO_4$(aq) | | | | |
| **3 (a)** | MMO decisions | Selects any named acid | 1 | |
| | MMO collection | Records brown gas with **FA 9** and no reaction with **FA 8** and **FA 10** | 1 | [2] |
| **(b)** | MMO decisions | **I** Selects: *(correct full name or formula)*<br>silver nitrate as first reagent, aqueous ammonia as second reagent, aqueous ammonia added to tube with $Ag^+$, 1st box ticked (*do not allow if $Pb^{2+}$ used as 2nd reagent)*<br>**or**<br>lead nitrate as first reagent, silver nitrate as second reagent, $Ag^+$(aq) added to fresh sample, 2nd box ticked | 1 | |
| | MMO collection | **II** <u>If $Ag^+$ used as 1st reagent</u><br>Give one mark for white ppt with **FA 8 and** cream ppt with **FA 10**<br><u>If $Pb^{2+}$ used as 1st reagent</u><br>Give one mark for white ppt with **FA 8 and FA 10**<br>*If* **FA 9** *not previously identified then no change/no reaction/no ppt*<br>*(ignore any yellow colouration of solution with $Pb^{2+}$)* | 1 | |
| | | **III** <u>If $Ag^+$ used as 1st reagent (with $NH_3$ as 2nd)</u><br>Give one mark if white ppt with **FA 8** is soluble in aqueous ammonia **and** cream ppt with **FA 10** is insoluble or partially soluble in aqueous ammonia<br><u>If $Ag^+$ used as 1st reagent (with $Pb^{2+}$ as 2nd)</u><br>Allow observations marks<br><u>If $Pb^{2+}$ used as 1st reagent (with $Ag^+$ as 2nd)</u><br>Give one mark for white ppt with **FA 8** and $Ag^+$ **and** cream ppt with **FA 10** and $Ag^+$.<br>*Ignore observations for* **FA 9**. | 1 | [3] |
| **(c)** | ACE conclusion | Mark consequentially on observations;<br>Give **one mark** for appropriate anions identified for **FA 8**, **FA 9** and **FA 10**.<br>(Allow from off-white or cream ppt for $Br^-$ + $Ag^+$) | 1 | [1] |

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| **(d)** | PDO recording | **I** Observations in a single table.<br>All additions of NaOH(aq) and $NH_3$(aq) shown to excess where there is an initial ppt | 1 | |
| | MMO collection | **II** All observations correct for **FA 11**<br>(Blue ppt in each, blue ppt insoluble in excess NaOH, soluble in excess $NH_3$ or forming/turning to a deep/dark blue solution) | 1 | |
| | | **III** All observations correct for **FA 12**<br>(White ppt insoluble in each) | 1 | [3] |
| **(e)** | ACE conclusion | **I** Mark consequentially to observations.<br>Expected conclusion is $Cu^{2+}$ in **FA 11** and $Mg^{2+}$ in **FA 12**<br>Allow $Ca^{2+}$ from white ppt insoluble in excess NaOH and no ppt with $NH_3$. | 1 | |
| | | **II** Gives appropriate evidence for each ion in the conclusion. Minimum evidence required for the expected ions:<br>**$Cu^{2+}$** Records a blue ppt with either of the reagents **or** deep blue solution with excess $NH_3$.<br>**$Mg^{2+}$** White ppt insoluble in excess $NH_3$ (or in each of the reagents) | 1 | [2] |
| **(f)** | MMO collection | **I** Blue, black, purple colour observed on adding starch in **(ii)** | 1 | |
| | | **II** The brown (solution) or (brown) solution formed in **(i)** is decolourised/colour fades/paler<br>**or**<br>brown (solution) in **(i)**<br>**and**<br>white, off-white or light brown ppt recorded. | 1 | |
| | ACE conclusion | Award **III** and **IV** for **two** correct pairs | 1 | |
| | | Award **III only** for **one** correct pair<br>Expected results<br>**(i)** $I^-$ is oxidised, $Cu^{2+}$ is reduced<br>**(ii)** $S_2O_3^{2-}$ is oxidised, $I_2$ is reduced<br>Mark horizontally or vertically. | 1 | [4] |
| | | | | **[Total: 15]** |