**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge International Advanced Subsidiary and Advanced Level**

# MARK SCHEME for the October/November 2014 series

## 9701 CHEMISTRY

**9701/36** Paper 3 (Advanced Practical Skills 2), 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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| Question | Indicative material | Mark | Total |
|---|---|---|---|
| 1 (a) | **I** The following data is shown<br>• two burette readings for the rough titration<br>• titre for rough titration<br>• initial and final burette readings for two (or more) accurate titrations (*Minimum of 2 × 2 boxes)*<br><br>*Correct headings and units for accurate titrations.*<br>*Headings should match readings*<br>• *Initial/start **and** (burette) reading/volume (not V or vol)*<br>• *Final/end **and** (burette) reading/volume*<br>• *Titre or volume/**FB 1 and** used/added (not difference, total or change)*<br>*Unit:/$cm^3$ or ($cm^3$) or in $cm^3$ or $cm^3$ for each reading.* | 1 | |
| | **II** All **accurate** burette readings are to nearest 0.05 $cm^3$.<br>The need to record to 0.05 $cm^3$ applies to the burette readings and not to the recorded titres but it does apply to 0.00 $cm^3$.<br><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 | |
| | **III** Has two uncorrected, accurate titres within 0.1 $cm^3$<br><br>*Do **not** consider the 'rough' even if ticked.*<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 any further titrations, within 0.1 $cm^3$ of any other titration have also been carried out.*<br>*Do **not** award this mark if any accurate burette readings (apart from initial 0) are given to **zero** dp.* | 1 | |
| | Round any burette readings to the nearest 0.05 $cm^3$.<br>Examiner selects the 'best' titres using the hierarchy:<br>• two (or more) accurate identical titres (ignoring rough), then<br>• two (or more) accurate titres within 0.05 $cm^3$, then<br>• two (or more) accurate titres within 0.10 $cm^3$ etc<br>These best titres should be used to calculate the mean corrected titre to the nearest 0.01 $cm^3$. | | |
| | Award **IV**, **V** and **VI** if $\delta < 0.2\ cm^3$<br>Award **IV** and **V** if $\delta > 0.2$ but $< 0.3\ cm^3$<br>Award **IV** if $\delta > 0.3\ cm^3$ but $< 0.4\ cm^3$.<br>Spread penalty: if the two best (corrected) titres used by the examiner were $> 0.5\ cm^3$ apart, cancel one Q mark. | 1<br>1<br>1 | [6] |

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|---|---|---|---|---|
| | **(b)** | **Calculation of mean**<br>Candidate must average two (or more) accurate titres with total spread of no more than 0.2 $cm^3$<br><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><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.*<br><br>*Do **not** award this mark if:*<br>*any selected titre is not within 0.20 $cm^3$ of any other selected titre;*<br>*the rough titre was used to calculate the mean;*<br>*the candidate carried out only 1 accurate titration;*<br>*burette readings were incorrectly subtracted to obtain any of the accurate titre values;*<br>*all burette readings (resulting in titre values used in calculation of mean) are integers.*<br><br>*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)** | $M_r$ $KIO_3$ = 214 | 1 | |
| | | Moles $dm^{-3}$ = $\frac{3.60}{40 \times 214}$ = $4.205 / 4.206 / 4.21 / 4.21 \times 10^{-4}$ | 1 | |
| | **(ii)** | Moles $S_2O_3^{2-}$ = **(i)** × 6 = $(2.52 \times 10^{-3})$ | 1 | |
| | **(iii)** | $\frac{\textbf{(ii)} \times 1000}{\text{vol from } \textbf{(b)}}$ | 1 | |
| | | Answers given to 3 or 4 sf | 1 | [5] |
| | | | | **[Total: 12]** |
| **2** | **(a)** | Round times to nearest second.<br>Supervisor calculates time with 10 $cm^3$ / time with 20 $cm^3$ (to 1 dp) and<br><br>awards 3 marks if within 1.9 to 2.1<br>awards 2 marks if within 1.8 to 2.2 (but not within 1.9 to 2.1)<br>awards 1 mark if within 1.6 and 2.4 (but not within 1.8 to 2.2) | <br><br><br>1<br>1<br>1 | <br><br><br><br><br>[3] |
| | **(b)** | **I** 3 additional volumes chosen with intervals not less than 2 $cm^3$. These must include 1 of < 10 $cm^3$ and 1 of > 10 $cm^3$ and have none < 4 $cm^3$. | 1 | |

| | | | |
|---|---|---|---|
| | **II** In all 3 additional experiments water is added to make a total of 20 $cm^3$. | 1 | |
| | **III** Tables in **(a)** and **(b)** to show volume **FB 5**, volume water and reaction time. All volumes measured to 0.05 $cm^3$. | 1 | |
| | **IV** All times recorded to nearest second. | 1 | [4] |
| **(c)** | Completes table correctly. | 1 | |
| | Correct headings and units including $cm^3$ s. | 1 | [2] |
| **(d)** | Agree: product **FB5** × reaction time is (approx) constant<br>Or<br>Disagree: product of **FB5** × reaction time is not constant | 1 | [1] |
| **(e)** | sodium thiosulfate is in excess – all the iodine reacts with the thiosulfate so no iodine produced (to turn blue-black). | 1 | [1] |
| **(f)** | (Carry out a series of reactions) keeping **volume** $S_2O_8^{2-}$ **(FB5)** constant (and timing to blue-black) | 1 | |
| | Alter volume $I^-$ **(FB4)** but keep total volume ($I^-$ and water) constant / keep $I^-$ and water volumes constant but change concentration of $I^-$. | 1 | [2] |
| | | | **[Total: 13]** |

**FB 7** is $MnCl_2$, **FB 8** is $KMnO_4$, **FB 9** is $CuCO_3$, **FB 10** is $CuSO_4$

| | | | |
|---|---|---|---|
| **3 (a) (i)** | White ppt | 1 | |
| **(ii)** | Off-white / buff / beige / light brown ppt **and** darkens on standing / insoluble in excess. | 1 | |
| **(iii)** | Brown / black colour | 1 | |
| **(iv)** | Effervescence / bubbling / fizzing **and** relights glowing splint | 1 | |
| | (Colour change) purple / pink to colourless | 1 | [5] |
| **(b)** | Manganese | 1 | [1] |
| **(c) (i)** | (Solid goes) black | 1 | |
| **(ii)** | Fizz / effervescence / bubbling **and** blue solution. | 1 | |
| | Limewater turns milky | 1 | |
| **(iii)** | Any **three** from<br><br>Solution goes paler<br>Pink / black / brown solid formed<br>Solution gets warmer<br>Fizz<br>Pop with lighted splint<br><br>3 correct answers scores 2<br>2 correct answers scores 1 | 2 | |
| **(iv)** | Solution turns / goes yellow / green | 1 | |
| **(v)** | Copper / $Cu^{2+}$ | 1 | |
| **(vi)** | 0 to (+)2 | 1 | [8] |
| **(e)** | Transition (elements) / d-block | 1 | [1] |
| | | | **[Total: 15]** |