Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

**CHEMISTRY** **9701/34**

Paper 34 Advanced Practical Skills 2 **May/June 2016**

MARK SCHEME

Maximum Mark: 40

**Published**

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** Initial and final readings **and** titre value given for rough titre **and** initial and final readings for two (or more) accurate titrations<br>*(minimum of 2 x 2 box)* | 1 | |
| | **II** Titre values recorded for accurate titrations<br>**and**<br>Appropriate headings for the **accurate** titration table **and** $cm^3$ units.<br>• initial / start burette reading / volume / value<br>• final / end burette and reading / volume / value<br>• titre **or** volume / **FB3 and** used / added<br>• unit: / $cm^3$ **or** ($cm^3$) **or** in $cm^3$ **or** $cm^3$ (for each heading) | 1 | |
| | **III** All **accurate** burette readings are to the nearest 0.05 $cm^3$.<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 | |
| | **IV** There are two (or more) uncorrected, **accurate** 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 two initial titres, **unless** a further titration, within 0.10 $cm^3$ of any other, has also been carried out.*<br>• *Do **not** award the mark if any "accurate" burette readings (apart from initial 0 $cm^3$) are given to **zero** dp.* | 1 | |
| | **V, VI** and **VII** Examiner rounds any accurate burette to the nearest 0.05 $cm^3$, checks subtractions and then select the **'best' titres** using the hierarchy:<br>• two (or more) accurate identical titres, *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 titre, expressed to nearest 0.01 $cm^3$.<br><br>Accuracy marks are awarded as shown.<br><br>Award **V**, **VI** and **VII** for $\delta \leqslant 0.30$ ($cm^3$)<br>Award **V** and **VI** for 0.30 $cm^3 < \delta \leqslant 0.60$ ($cm^3$)<br>Award **V** for 0.60 $cm^3 < \delta \leqslant 1.00$ ($cm^3$) | 3 | [7] |

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| **(b)** | Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 $cm^3$.<br>Working must be shown **or** ticks must be put next to the two (or more) accurate readings selected.<br>The mean should be quoted to **2 dp**, rounded to the nearest 0.01.<br><br>Two special cases where the mean may not be to 2 dp:<br>• Allow mean expressed to 3 dp **only** for 0.025 or 0.075 (e.g. 26.325)<br>• Allow mean if expressed to 1 dp if **all** accurate burette readings were given to 1 dp **and** the mean is **exactly** correct.<br>*(e.g. 26.0 and 26.2 = 26.1 is allowed)*<br>*(e.g. 26.0 and 26.1 = 26.1 is incorrect – should be 26.05.)*<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)** | Correctly calculates n(HC*l*) used = $\frac{0.008 \times (\mathbf{b})}{1000}$ | 1 | |
| **(ii)**<br><br>**(iii)** | Correct use of factors<br>n(borax) = 0.5 × answer **(i)**<br>**and**<br>n(borax) = 40 × answer **(ii)** | 1 | |
| **(iv)** | Correct use of **(iii)** and 15.5<br>$M_r = \frac{15.5}{(iii)}$ | 1 | |
| **(v)** | Correct expression<br>$x = \frac{(iv) - 338}{(10.8)}$ | 1 | |
| | All answers to 3 or 4 significant figures<br>**and** if answer **(v)** is attempted it must be an integer | 1 | [5] |
| **Question 2** | | | **[13]** |

| Question | Indicative material | Mark | Total |
|---|---|---|---|
| 2 (a) | **I** Appropriate headings **and** units for the three balance readings<br>• (Mass of) crucible (and lid)<br>• (Mass of) crucible, (lid) and **FB 4** (or "contents before heating")<br>• (Mass of) crucible, (lid) and residue / MgO / contents after heating / **FB 4** after heating<br>• Unit covering **all** balance readings and subtracted values if shown: / g, (g), in g **or** g (for each heading) | 1 | |
| | **II** Masses recorded<br>• Mass of **FB 4** used was claimed to be between 1.1–1.3 g<br>• **All** balance readings recorded to same number of decimal places *(at least one dp)* | 1 | |
| | **III** Mass of **FB 4** and of residue<br>• Mass of **FB 4** used, correctly subtracted<br>• Mass of residue, correctly subtracted | 1 | |
| | **IV** and **V**<br>• Use corrected values<br>• Examiner used corrected values and works out the ratio $\frac{\text{mass of FB 4}}{\text{mass of MgO}}$ to 1 dp for the candidate<br>Accuracy marks are awarded as shown.<br><br>Award **IV** if ratio between 1.4–2.5<br>Award **V** if ratio between 1.7–2.3 | 2 | [5] |
| (b) (i) | Correctly calculates n(MgO)<br>• $\frac{\text{mass of residue}}{40.3}$<br>• *Answer must be expressed to 2, 3 or 4 significant figures* | 1 | |
| (ii) | Correct use of **(i)** and mass of **FB 4**<br>• n(**FB 4**) = $\frac{\text{answer (i)}}{2}$<br>• $M_r = \frac{\text{mass of FB 4 used}}{\text{no of moles of FB 4}}$<br>• *An answer for $M_r$ must be quoted to 2 or more significant figures* | 1 | |
| (iii) | $M_r$ calculated from $A_r$ values in Periodic Table = 178.6 | 1 | |
| (iv) | Correct expression shown<br>$\frac{2.5}{100} \times M_r$ in **(iii)** (= 4.5, 4.47, 4.465)<br>**or** expresses % difference of the two $M_r$ values<br>$= \frac{\lvert \text{(iii)} - \text{(ii)} \rvert}{\text{(iii)}} \times 100$<br>**or (iii)** $\times \frac{97.5}{100}$ / **(iii)** $\times \frac{102.5}{100}$ to give range (= 174(.1) – 183(.1)) | 1 | |
| | Makes a correct statement (support / does not support / yes / no) about the accuracy of the possible formula, explained by whether the experimental $M_r$ value is close to the answer in **(iii)**.<br>*Numbers must be quoted or reference made to **(ii)** and **(iii)*** | 1 | [5] |

| | | | |
|---|---|---|---|
| **(c) (i)** | Improvement<br>Heat (crucible and residue) to constant mass<br>*Accept a description of the procedure for the mark*<br>**or** heat more strongly / to a higher temperature<br>**or** heat for longer so more is decomposed<br>If a **1 dp** balance is used allow use a balance weighing to more dp **and** to reduce % error (in weighing) / give more precise mass | 1 | |
| **(ii)** | Conclusion<br>To find out whether the two experiments are reliable / consistent / concordant<br>**or**<br>If the experiments do not agree then carry out a 3rd / another expt<br>**or**<br>If one experiment was inaccurate because it gave a poor $M_r$ value it can be ignored | 1 | |
| **(iii)** | Error is 0.005 g or 0.01 g *(if 2 dp balance was used)*<br>*(If a 3 dp balance was used, error is 0.0005 or 0.001 g)*<br>*(If a 1 dp balance was used, error is 0.05 or 0.1 g)* | 1 | |
| | % = 100 × 2 × error / mass of **FB 4**<br>*Accept correct expression **or** correct answer to 2, 3 or 4 significant figures* | 1 | [4] |
| **Question 2** | | | **[14]** |

**FB 5** is $BaCl_2$; **FB 6** is $AgNO_3$; **FB 7** is $H_2SO_4$; **FB 8** is $NaHCO_3$

**3 (a)**

**Three** correct observations with Mg
**Three** correct observations with NaOH
**Three** correct observations with KI

| *test* | **FB 5** | **FB 6** | **FB 7** |
|---|---|---|---|
| Mg | no reaction / no change (ignore few bubbles (on Mg) / gas produced slowly) | grey / black **and** ppt / solid / coating / deposit **or** Mg goes black / grey | fizzing / bubbling / effervescence |
| NaOH | no change / no reaction / no ppt / (solution) stays colourless *Allow white ppt / cloudy white* soluble in excess is CON | (dark) brown ppt soluble in excess is CON *Allow brown ppt as final colour after a paler shade of brown but not a different colour (e.g. green / yellow / red)* | no change / no reaction / (solution) remains colourless / no ppt **or** temperature rises *Allow heat produced but not exothermic* |
| KI | no change / no reaction / (solution) remains colourless *Accept pale yellow solution* | (pale) yellow ppt *Allow greenish yellow (but not yellowish green) Allow cream-yellow* | no change / no reaction / (solution) remains colourless *Accept pale yellow solution* |

| **FB 5** | | white ppt | white ppt |
|---|---|---|---|
| (Mg) | | | gas / $H_2$ (evolved) pops with lighted splint / spill |

3

**Two** correct observations with **FB 5** — 1

Correct hydrogen gas test — 1 [5]

| | | | |
|---|---|---|---|
| **(b) (i)** | Conclusion **and** reason<br><br>Cation is silver / $Ag^+$ (allow lead(II) / $Pb^{2+}$) **and**<br>Gives yellow precipitate (with iodide ions) **or** AgI ($PbI_2$) produced | 1 | |
| **(ii)** | Both conclusions about **FB 5** are correct<br>• cation – barium / $Ba^{2+}$<br>• anion – chloride / $Cl^-$ | 1 | |
| **(iii)** | **FB 7** is sulfuric acid / $H_2SO_4$ | 1 | |
| **(iv)** | $Mg + 2H^+ \rightarrow Mg^{2+} + H_2$ | 1 | [4] |
| **(c) (i)** | Any two observations from:<br>• Condensation / water formed (inside test tube)<br>• Steam liberated / hissing / (water) vapour produced / steamy / misty fumes<br>• White residue / solid remains white / white solid formed | 1 | |
| | Gas / $CO_2$ turns lime water milky / white precipitate / cloudy white / chalky | 1 | |
| **(ii)** | Any two observations from:<br>• Fizzing / bubbling / effervescence<br>• Reaction is rapid / vigorous<br>• Solid dissolves / colourless solution formed (at end)<br>• Temperature drops / it gets colder | 1 | |
| **(iii)** | Both conclusions required<br>• cation – not known / not transition metal<br>• anion – carbonate / $CO_3^{2-}$ **or** hydrogencarbonate / $HCO_3^-$ | 1 | [4] |
| **Question 3** | | | **[13]** |