**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

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

# MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

## 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.

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| Question | Sections | Indicative material | Mark | |
|---|---|---|---|---|
| **1 (a)** | PDO Layout | Constructs a table for results to show volume **FB 1**, volume distilled water and time. | 1 | |
| | PDO Recording | Correct headings and units. *Units must have solidus: /s; brackets: (s); or describe in words: time in seconds or time in s. Units of volume: $cm^3$ with solidus etc. as above.*<br>*All recorded readings must have units.*<br>If units in headings they must not be repeated for each individual reading. | 1 | |
| | | All times recorded to 1 second. Volumes of **FB 1** and water to 1 or 0.05 $cm^3$. | 1 | [3] |
| **(b)** | MMO Decision | Two additional volumes of propanone chosen both of which are less than 20 $cm^3$.<br>*These must not be more than one in the region 20–14, 14–8 and < 8 and not within 1 $cm^3$ of the original values.* | 1 | |
| | MMO Collection | In both additional experiments water is added to make a total of 20 $cm^3$.<br>*Some **FB 1** must be used.* | 1 | [2] |
| **(c)** | PDO Display | **(i)** Working shown and answer = $5 \times 10^{-5}$ mol. | 1 | |
| | | **(ii)** Working shown and answer = $(5 \times 10^{-5}) / 0.050 = 1 \times 10^{-3}$ ecf from **(i)**. | 1 | [2] |
| **(d)** | ACE Interpretation | Calculates the rate correctly using ans **(c) (ii)** $\times 10^5$/ time.<br>*Answers given to minimum 2 sig figs.* | 1 | |
| | PDO Recording | Units for rate given as mol $dm^{-3}s^{-1}$. | 1 | [2] |

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|---|---|---|---|---|
| **(e)** | PDO Layout | **I** Rate on *y*-axis and volume on *x*-axis. Axes clearly labelled. | 1 | |
| | | **II** Uniform scale chosen to use at least 6 large squares on *y*-axis and 4 on *x*-axis. This can include 0,0 if point plotted or line extrapolated. Ignore extrapolation > 20. | 1 | |
| | | **III** Plotting of points. Points to be within ½ small square and in correct square. All recorded values should be plotted. | 1 | |
| | | **IV** Draws a line of best fit. | 1 | |
| | MMO Quality | Award **V** and **VI** for $\delta$ = ± 3 s | 1 | |
| | | Award **V** only for $\delta$= ± 6 s | 1 | |
| | | Award **VII** and **VIII** for $\delta$ = ± 8 s | 1 | |
| | | Award **VII** only for $\delta$ = ± 16 s | 1 | [8] |
| **(f)** | ACE Conclusion | Notes linear relationship/(directly) proportional/ reaction is 1st order with respect to propanone. Rate increases as concentration (volume) increases would score one. | 2 | |
| | ACE Improvement | Other volumes of **iodine** and repeat for varying volumes of propanone/repeat values for each run/carry out **all** experiments again/repeat any anomalous results/use burettes for **FB 2 OR FB 3/** carry out **relevant** specified experiments/use a colorimeter/use starch to show colour change/ minimise intervals in volumes used. *Do not allow: carry out more experiments/use other volumes of **propanone**/do experiments again/effects of changing conditions.* | 1 | [3] |
| **(g)** | MMO Decision | Uses 5 $cm^3$ of iodine solution with extra 5 $cm^3$ of distilled water. | 1 | |
| | ACE Interpretation | Uses the expression **(c) (ii)**/2 and time from **(g)**. *Time must be different from that in **(d)**.* | 1 | [2] |
| **(h)** | ACE Conclusion | Makes logical statement to compare rate with corresponding rate in **(d)**. | 1 | [1] |

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| **(i)** | ACE Interpretation | Uncertainty in each measurement is 0.05 $cm^3$/0.1 $cm^3$ is overall burette error.<br>$\frac{0.10}{20.0} \times 100 = 0.50\%$<br>0.50 alone scores 2<br>*$\frac{0.05}{20.0} \times 100 = 0.25\%$ scores 1* | 1<br>1 | [2] |
| | | | | **[Total: 25]** |

| | | | | |
|---|---|---|---|---|
| **FB 4** is $H_2SO_4$; **FB 5** is $Pb(NO_3)_2$; **FB 6** is $(NH_4)_2CO_3$ | | | | |
| **2 (a)** | MMO Decision | **(i)** Named reagent involving $CrO_4^{2-}$ or $CO_3^{2-}$ solution/ Mg.<br>*Allow NaOH **only** if increase in T for **FB 4** is used.* | 1 | |
| | MMO Collection | **(ii)** **FB 4** gives orange solution/**FB 4** gives effervescence/ / **FB 4** gives effervescence<br>*Gas liberated not allowed unless test for gas given*.<br>**FB 5** gives yellow ppt/white ppt/no reaction/black ppt.<br>**FB 6** gives yellow solution/no reaction/no change. | 3 | [4] |
| **(b)** | MMO Collection | **FB 4** + **FB 5 and FB 5** + **FB 6** white ppt.<br>**FB 6** + **FB 4** effervescence/bubbling.<br>**Gas** turns limewater milky/cloudy/chalky. | 1<br>1<br>1 | [3] |
| **(c)** | PDO Recording | Presents information in a table to include both reagents and excess of each.<br>*Ignore anything described as the acid in **(a)**.*<br>*No additional reagents allowed.*<br>**FB 5** gives white ppt soluble in excess NaOH and white ppt insol in excess $NH_3$(aq).<br>**FB 6** gives no reaction with either NaOH or $NH_3$(aq).<br>(Warms **FB 6** + NaOH and tests) gas/ammonia turns damp red litmus blue.<br>**FB 4** no change scores 1. | 1<br>1<br>1<br>1 | [4] |

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| **(d)** | ACE Conclusions | All conclusions must follow observations.<br>For each unknown. One mark for ion and one mark for satisfactory evidence. | | |
| | | **FB 5** If $CrO_4^{2-}$ in **(a)**, $Pb^{2+}$ (1) | 1 | |
| | | Evidence: yellow ppt and white ppt with NaOH or $NH_3$ (1) | 1 | |
| | | **or** if not $CrO_4^{2-}$ in **(a)** $Al^{3+}$ or $Pb^{2+}$ (both needed) (1) | | |
| | | Evidence $NH_3$ (ignore NaOH) (1) | | |
| | | One of $Al^{3+}$ or $Pb^{2+}$ can score MP 2. | | |
| | | **FB 6** $NH_4^+$/ $CO_3^{2-}$ (1) | 1 | |
| | | Evidence: formation of $NH_3$/$CO_2$ from appropriate tests (1) | 1 | |
| | | **or FB 6** $Ba^{2+}$ or $NH_4^+$ (both needed) (1) | | |
| | | Evidence: no ppt **both** NaOH and $NH_3$ (1) | | [4] |
| | | | | **[Total: 15]** |

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