

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

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

**MARK SCHEME for the May/June 2012 question paper  
for the guidance of teachers**

**9701 CHEMISTRY**

**9701/31**

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

|        |                                |          |       |
|--------|--------------------------------|----------|-------|
| Page 2 | Mark Scheme: Teachers' version | Syllabus | Paper |
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| Question | Sections           | Indicative material   | Mark   |
|----------|--------------------|---|--------|
| 1 (a)    | PDO layout         | <b>I</b> Constructs a table for results   | 1      |
|          | PDO recording      | <b>II</b> Appropriate headings and units for data given. Volume / V in cm <sup>3</sup> , / cm <sup>3</sup> or (cm <sup>3</sup> ) Time/t in seconds, /s or (s)   | 1      |
|          | PDO recording      | <b>III</b> All times recorded to the nearest second.  | 1      |
|          | MMO decision       | <b>IV</b> 3 additional volumes chosen with intervals not less than 2.00 cm <sup>3</sup> and all volumes of <b>FA 1</b> greater or equal to 6.00 cm <sup>3</sup>   | 1      |
|          | MMO collection     | <b>V</b> In all 3 additional experiments water is added to make a total of 20.00 cm <sup>3</sup>  | 1      |
|          | MMO quality        | Round times to nearest second.<br><b>VI + VII</b> Compare time for 20.00 cm <sup>3</sup> of <b>FA 1</b> with that of supervisor.<br><b>VIII + IX</b> Compare time for 10.00 cm <sup>3</sup> of <b>FA 1</b> with that of supervisor.<br>The range for award of 1 or 2 depends on the supervisor value.<br><br>Supervisor value:<br>< or = 15 δ for 2 is 2 and for 1 is 4<br>16 to 30 δ for 2 is 3 and for 1 is 6<br>31 to 45 δ for 2 is 4 and for 1 is 8<br>46 to 60 δ for 2 is 5 and for 1 is 10<br>> 60 δ for 2 is 6 and for 1 is 12 | 2<br>2 |
|          |                    |   | [9]    |
| (b)      | PDO display        | <b>(i)</b> Working to show ans = 5 × 10 <sup>-5</sup> mol   | 1      |
|          | ACE interpretation | <b>(ii)</b> 0.5 x ans to <b>(b)(i)</b> = 2.5 × 10 <sup>-5</sup> mol   | 1      |
|          | PDO display        | <b>(iii)</b> Working to show that:<br>(2.5 × 10 <sup>-5</sup> ) / 0.050 =<br>(5 × 10 <sup>-4</sup> mol dm <sup>-3</sup> )   | 1      |
|          |                    |   | [3]    |
| (c)      | ACE interpretation | Rate correctly calculated using ans <b>(b)(iii)</b> / time (or 4.25 × 10 <sup>-4</sup> ). Min 2 s.f. rounded correctly and minimum 4 results.   | 1      |
|          | PDO recording      | Unit for rate given as mol dm <sup>-3</sup> s <sup>-1</sup> .   | 1      |
|          |                    |   | [2]    |

|        |                                |          |       |
|--------|--------------------------------|----------|-------|
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| Question | Sections           | Indicative material  | Mark        |
|----------|--------------------|--|-------------|
| (d)      | PDO layout         | I Rate on y-axis and volume on x-axis. Axes clearly labelled (ignore units)  | 1           |
|          |                    | II Linear scale chosen to use at least half of each axis (need not include 0, 0)<br>If no point at 0, 0 cannot count for > half.                     | 1           |
|          |                    | III Plotting of points.<br>Minimum of 3 readings.  | 1           |
|          |                    | IV Draws a line of best fit. Minimum 4 readings including 0, 0 (if plotted).   | 1           |
|          |                    |  | [4]         |
| (e)      | ACE conclusion     | Rate is proportional to peroxodisulfate <b>concentration</b><br>Rate increases as concentration (volume) increases<br>would score one                | 2           |
|          |                    |  | [2]         |
| (f)      | ACE interpretation | (i) correctly calculates $(0.5 / \text{time from Expt 1}) \times 100$ .<br>Minimum of 2 s.f.   | 1           |
|          |                    | (ii) $\frac{\text{ans (b)(iii)}}{\text{Expt 1 time} + 0.5} \times 10^6 \text{ mol dm}^{-3} \text{ s}^{-1}$<br><b>or</b><br>Rate– (% from (i) × rate) | 1           |
|          |                    | (iii) Any reasonable suggestion e.g. difficult to judge colour change / measurement of volumes / variation in T                                      | 1           |
|          | ACE improvement    | use of colorimeter / burettes for all volumes / (thermostatic) waterbath.<br>Not air conditioning.   | 1           |
|          |                    |  | [4]         |
| (g)      | ACE conclusion     | (ii) Thiosulfate concentration / number moles / volume is doubled (1)<br>Time is longer/ reaction is slower with more thiosulfate (1)                | 2           |
|          |                    |  | [2]         |
|          |                    |  | [Total: 26] |

|        |                                |          |       |
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| Question   | Sections       | Indicative material   |                                   |   | Mark               |
|--|----------------|---|-----------------------------------|---|--------------------|
| <b>FA 5 = CuCl<sub>2</sub>; FA 6 = NaOH; FA 7 = Pb(NO<sub>3</sub>)<sub>2</sub>; FA 8 = K<sub>2</sub>CrO<sub>4</sub>; FA 9 = MgSO<sub>4</sub></b> |                |   |                                   |   |                    |
| 2 (a)  | MMO collection | Blue ppt insol in excess (1)<br>Not 'dark blue'   | White ppt (1)<br>Ignore 'excess'. | Yellow / brown / greenish-brown ppt (1)<br>Not 'orange, red, red / brown'<br>Ignore excess. | [5]                |
|  |                |   | White ppt soluble in excess (1)   | No reaction / yellow solution<br><b>and</b><br>yellow ppt soluble in excess<br>CONs ppt (1) |                    |
| (b)  | ACE conclusion | Cu <sup>2+</sup> in <b>FA 5</b> <b>AND</b> CrO <sub>4</sub> <sup>2-</sup> in <b>FA 8</b>                  |                                   |   | 1                  |
|  |                | Pb <sup>2+</sup> in <b>FA 7</b> <b>AND</b> OH <sup>-</sup> in <b>FA 6</b>                                 |                                   |   | 1                  |
|  |                | Cl <sup>-</sup> in <b>FA 5</b>  |                                   |   | 1 [3]              |
| (c)  | MMO decision   | <b>I</b> Add Pb (NO <sub>3</sub> ) <sub>2</sub> or BaCl <sub>2</sub> or Ba(NO <sub>3</sub> ) <sub>2</sub> |                                   |   | 1                  |
|  | MMO decision   | <b>II</b> Add HNO <sub>3</sub> or HCl   |                                   |   | 1                  |
|  | PDO recording  | <b>III</b> Presents observations in a single table – no extra reagents.<br>Must be > 2 'boxes'            |                                   |   | 1                  |
|  | MMO collection | <b>IV</b> White ppt   |                                   |   | 1                  |
|  | MMO collection | <b>V</b> No SO <sub>2</sub> evolved or ppt insoluble  |                                   |   | 1                  |
|  | ACE conclusion | <b>VI</b> sulfate   |                                   |   | 1                  |
|  |                |   |                                   |   | <b>[Total: 14]</b> |