MARK SCHEME for the May/June 2006 question paper

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published Report on the Examination.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the Report on the Examination.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

- CIE will not enter into discussion or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2006 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
1 (a) Give one mark if all times in Table 1.1 are recorded to the nearest second (no decimal places shown) [1]

Give one mark for recording \( \log_{10} \left( \frac{1000}{\text{time}} \right) \) to 2 decimal places. [1]

Convert to seconds any time which is clearly in “stop-clock” format e.g. 1.06 or 1.06.33

Calculate (volume of FB 1 x candidate’s recorded time) for Experiments 1, 2 and 3. Record the Vt for each experiment to the left of Table 1.1 against the appropriate experiment.

Calculate: \( \frac{\text{Largest Vt value} - \text{Smallest Vt value}}{\text{Largest Vt value}} \times 100 \)

If this value is \( \leq 5\% \) award the maximum of 6 accuracy marks.

If this value is greater than 5%, select the closer pair and calculate the % in a similar way:

\( \frac{\text{Larger Vt value} - \text{Smaller Vt value}}{\text{Larger Vt value}} \times 100 \) then

Calculate the difference between the remaining Vt value and the value used in the expression above which is further from it (i.e. the larger of the two possible differences).

Use this difference to calculate: \( \frac{\text{Difference between 3rd value and further of pair}}{\text{Further of pair}} \times 100 \)

e.g. 1800] 1760] 1590

Take the difference between 1590 and 1800, the further of the 5% pair.

The difference (210) is calculated as a % of 1800, the further of the 5% pair.

\( \frac{210}{1800} \times 100 = 11.7\% \) 1 within 20%

e.g. 1400] 1290] 1250]

Take the difference between 1400 and 1250, the further of the 5% pair.

The difference (150) is calculated as a % of 1290, the larger of the 5% pair.

\( \frac{150}{1250} \times 100 = 12.0 \% \) 1 within 20%

Award accuracy marks as shown on the following page:
Award accuracy marks as follows:

<table>
<thead>
<tr>
<th>6 Marks</th>
<th>5 Marks</th>
<th>4 Marks</th>
<th>3 Marks</th>
<th>2 Marks</th>
<th>1 Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All 3 Vt values within 5% of largest</strong></td>
<td>2 Vt values within 5% of the larger of the closer pair</td>
<td>Spread of all 3 values is ≤ 10% of the larger of the 5% pair</td>
<td>2 Vt values within 5% of the larger of the closer pair</td>
<td>Spread of all 3 values is ≤ 25% of the larger of the 5% pair</td>
<td>2 Vt values within 5% of the larger of the closer pair</td>
</tr>
</tbody>
</table>

| **All 3 Vt values within 7.5% of largest** | 2 Vt values within 7.5% of the larger of the closer pair | Spread of all 3 values is ≤ 12.5% of the larger of the 5% pair | 2 Vt values within 7.5% of the larger of the closer pair | Spread of all 3 values is ≤ 30% of the larger of the 5% pair | Any 2 Vt values within 7.5% of the larger of the closer pair |

| **All 3 Vt values within 10% of largest** | 2 Vt values within 10% of the larger of the closer pair | Spread of all 3 values is ≤ 15% of the larger of the 5% pair | 2 Vt values within 10% of the larger of the closer pair | Spread of all 3 values is ≤ 35% of the larger of the 5% pair | Any 2 Vt values within 10% of the larger of the closer pair |

| **All 3 Vt values within 12.5% of largest** | 2 Vt values within 12.5% of the larger of the closer pair | Spread of all 3 values is ≤ 17.5% of the larger of the 5% pair | 2 Vt values within 12.5% of the larger of the closer pair | Spread of all 3 values is ≤ 30% of the larger of the 5% pair | Any 2 Vt values within 12.5% of the larger of the closer pair |

| **All 3 Vt values within 15% of largest** | 2 Vt values within 15% of the larger of the closer pair | Spread of all 3 values is ≤ 25% of the larger of the 5% pair | 2 Vt values within 15% of the larger of the closer pair | Spread of all 3 values is ≤ 25% of the larger of the 5% pair | Any 2 Vt values within 15% of the larger of the closer pair |

| **All 3 Vt values within 17.5% of largest** | 2 Vt values within 17.5% of the larger of the closer pair | Spread of all 3 values is ≤ 25% of the larger of the 5% pair | 2 Vt values within 17.5% of the larger of the closer pair | Spread of all 3 values is ≤ 25% of the larger of the 5% pair | Any 2 Vt values within 17.5% of the larger of the closer pair |
Graph

Give one mark if \( \lg \left( \frac{1000}{\text{time}} \right) \) is plotted on the y axis and \( \lg(\text{volume of FB 1}) \) on the x axis, both axes have been labelled (ignore units) and easily used linear scales with points plotted over 50% of each axis have been used. [1]

The Examiner is to check the plotting of the five points.

Give two marks if all five points (candidate's values) are plotted within \( \frac{1}{2} \) small square (and in the correct small square), in either direction, of the point selected by the Examiner.

Deduct one mark for each point incorrectly plotted (no negative marks). [2]

Give one mark for a best-fit straight line.

If points are not in line or very close to being in line, the line of best fit must be drawn so as to 'cancel out' any discrepancies. The total distance (perpendicular to the drawn line) to the left should equal (as far as possible) the total distance to the right. If the candidate makes it clear that a point is being ignored this mark can be given for a line drawn through 4 points alone.

This mark is unlikely to be awarded where points are incorrectly plotted (or there has been error in calculation in Table 1.1). If all the points are within a 4 adjacent squares, do not give this mark. [1]

(c) Give one mark for stating that there is a constant (total) volume in each experiment. [1]

(d) Give one mark for stating that the volume of FB 1 is proportional to its concentration (or equivalent statement).

Providing that a mark has been given in (c) or the candidate states in (d) that the total volume is kept constant -

Give one mark for \([\text{Na}_2\text{S}_2\text{O}_3]\) is directly proportional to. volume of FB 1 or equivalent mathematical expression

There is no retrospective mark in (c) for a candidate who refers to constant (total) volume in (d) [2]

(e) Give one mark for construction lines on the graph or graph extended to axes

Give one mark for numerical values (from the construction) used in a calculation

Give one mark for a suggested order that fits the experimental value. Do not give if calculation inverted. [3]
(f) Give one mark if the total volume of solution is 55 cm$^3$ in each experiment
Give one mark if the volume of FB 1 is 40 cm$^3$ in each experiment
Penalise 1 mark if the volumes are exactly the same as in expt. 2.
Penalise 1 mark if volume of FB2 is same in two or more experiments.
Give one mark for correctly calculating $\frac{1000}{\text{time}}$ for both experiments 6 and 7.
Each answer must be correctly rounded to the significant figure shown (minimum is 2 s.f.) [3]

(g) Give one mark for a comment on rate (or time)/concentration of HCl that fits the experimental results.

[1]

[Total: 22]
ASSESSMENT OF PLANNING SKILLS.

(a) Give one mark if the apparatus is suitable for: heating and reducing the copper oxide in a stream of hydrogen gas.

Give one mark for “real apparatus” that:
- is capable of being disconnected to weigh oxide/copper and water (Ignore any chemical included to absorb condensate);
- shows how the steam is condensed to water.

Give one mark for a suitable means of burning excess hydrogen at the end of the apparatus. [3]

(b) Give one mark for any of the following:

(i) flushing the apparatus with an inert gas,

(ii) passing hydrogen through the apparatus to flush out air,

(iii) testing small portions of mixture (e.g. in a test-tube) before igniting excess.

(iv) remove air from the apparatus – by some practical method, e.g. evacuation [1]

(c) Give one mark for preventing copper from re-oxidising / keeping air away from the hot copper or equivalent. [1]

(d) Give one mark for reference to reheating/reweighing or heating to constant mass. [1]

(e) Give one mark for a calculation to obtain appropriate moles of CuO and Cu₂O, water, copper.

Give one mark for relating the calculated moles to quantities in the equation. [2]

[Total: 8]