

## MARK SCHEME for the May/June 2007 question paper

### 9701 CHEMISTRY

**9701/32**

Paper 32 (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.

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.

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

CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



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| <b>Skill</b>                              |          | <b>Breakdown of marks</b>  |         |
|---|----------|--|---------|
| Manipulation, measurement and observation | 16 marks | Successful <u>collection</u> of data and observations                          | 8 marks |
|   |          | <u>Decisions</u> relating to measurements or observations                      | 8 marks |
| Presentation of data and observations     | 12 marks | <u>Recording</u> data and observations   | 5 marks |
|   |          | <u>Display</u> of calculation and reasoning                                    | 3 marks |
|   |          | Data <u>layout</u>   | 4 marks |
| Analysis, conclusions and evaluation      | 12 marks | <u>Interpretation</u> of data or observations and identifying sources of error | 6 marks |
|   |          | Drawing <u>conclusions</u>   | 5 marks |
|   |          | Suggesting <u>improvements</u>   | 1 mark  |

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| Question    | Sections           | Indicative material   | Mark       |     |
|-------------|--------------------|---|------------|-----|
| 1 (a) (i)   | PDO Layout         | Tabulates initial and final burette readings and volume added in each of the tables<br><i>Tabulation may be vertical or horizontal.</i><br><i>Ignore absence of units</i><br><i>Do NOT award this mark if any final and initial burette readings are inverted or 50 is used as the initial burette reading</i>  | [1]        |     |
| (ii)        | PDO Recording      | Both burette readings in the dilution table and <u>final and initial</u> burette readings for all accurate titres in the titration table recorded to the nearest 0.05 cm <sup>3</sup> .<br><i>Treat all titres as “accurate” unless labelled rough or trial</i>   | [1]        |     |
| (iii)       | MMO Collection     | Follows instructions – Rough plus sufficient accurate titrations<br><i>Award this mark if there are three or more titres <u>OR</u> where two titres only have been recorded they are within 0.20 cm<sup>3</sup> (neither labelled as rough).</i><br><i>The first titre does not have to be labelled rough</i>   | [1]        |     |
| (iv)        | MMO Decisions      | Has at least two uncorrected titres within 0.1 cm <sup>3</sup><br><b>Accuracy (v) and (vi)</b><br>Give 2 marks if difference to Supervisor is <b>0.3</b> or less<br>Give 1 of these two marks for a difference of <b>0.3+ to 0.5</b><br>Give 0 marks for a difference greater than <b>0.5</b>   | [1]<br>[2] | [6] |
| (b)         | ACE Interpretation | Candidate selects/calculates appropriate “average” from any uncorrected titre values within 0.20 cm <sup>3</sup> .  | [1]        | [1] |
| (c) (i)(ii) | ACE Interpretation | Examiner checks each of the first four steps of the calculation.<br>Award two marks if all steps are chemically correct.<br>Withhold 1 mark for each chemical error – no negative marks. Count non-completed steps as chemical errors.<br>step 1 $\frac{\text{titre}}{1000} \times 0.0120$<br>step 2 $\times 5$<br>step 3 $\times \frac{1000}{25}$<br>step 4 $\times \frac{250}{\text{volume diluted}}$ | [2]        |     |
| (iii)       | PDO Display        | Working shown in each step attempted  | [1]        |     |
| (iv)        |                    | 3 or 4 significant figures in final answer given for each of the first four steps   | [1]        |     |
| (v)         |                    | Answer to last section is correctly evaluated to 4 sf for (candidate’s value to 4 <sup>th</sup> step $\times 392$ ).<br><i>(Answer may be from final answer to step 4 or using number carried on calculator).</i>   | [1]        | [5] |

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| <b>Question</b> | <b>Sections</b>       | <b>Indicative material</b>   | <b>Mark</b>        |     |
|-----------------|-----------------------|--|--------------------|-----|
| <b>(d)</b>      | ACE<br>Improvement    | Candidate suggests heating solution to eliminate air OR suggests practical way of storing water without air re-dissolving <ul style="list-style-type: none"> <li>• Storing in a full bottle (no air space)</li> <li>• Ignore and reference to vacuum (pump)</li> </ul> | [1]                | [1] |
| <b>(e)</b>      | ACE<br>Interpretation | Smallest division correctly read from burette and error estimated at $\frac{1}{2}$ smallest division<br><i>Burettes are graduated at <math>0.1 \text{ cm}^3</math></i>   | [1]                | [1] |
| <b>(f)</b>      | ACE<br>Interpretation | Doubles error in reading to get maximum possible error   | [1]                | [1] |
| <b>(g)</b>      | ACE<br>Conclusions    | Explains that errors are identical (in the same direction) (and cancel).   | [1]                | [1] |
|                 |                       |  | <b>[Total: 16]</b> |     |

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| Question | Sections  | Indicative material  | Mark                                |     |
|----------|---|--|-------------------------------------|-----|
| 2 (a)    | MMO<br>Decisions  | Calculates the minimum mass of $\text{NaHCO}_3$ needed to give an excess. (10.08 g)<br><i>Do not penalise rounding to 10.1 g if 10.08 has been shown in calculation</i>  | [1]                                 | [1] |
| (b)      | PDO Layout<br><br>PDO<br>Recording<br><br>MMO<br>Collection | Tabulates all experimental readings:<br>(mass of empty weighing bottle, mass of bottle + solid, mass of bottle + residual solid, initial temperature, final temperature) and $\Delta T$ .<br><br>Single table covering both experiments<br><br>Table has correct labels and units ( <u>only g and °C</u> )<br><br>All weighings recorded with consistent precision to at least 1 dp and all temperature readings recorded to 1 dp only<br><br>Give one mark if difference between (all) candidate's $\Delta T$ values, <b>as calculated by the Examiner</b> , is within 0.5 °C<br><br>Give one mark if the difference between mean $\Delta T$ value for Supervisor and closer/closest $\Delta T$ value of candidate, <b>as calculated by the Examiner</b> , is within 0.5 °C | [1]<br><br>[1]<br>[1]<br>[1]<br>[1] | [6] |
| (c)      | ACE<br>Interpretation                                       | Examiner calculates to 1 decimal place the mean $\Delta T$ value from the candidate's $\Delta T$ values for each experiment.<br><br>Give 1 mark if the candidate's answer to (d) is within 1% of (examiner calculated mean $\Delta T \times 4.3$ ) and the correct sign (+) is given.  | [1]                                 | [1] |
|          |   |  | <b>[Total: 8]</b>                   |     |

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| Question  | Sections                      | Indicative material   | Mark |     |
|---|-------------------------------|---|------|-----|
| <b>FB 6 is iron(III) chloride; FB 7 is chromium(III) iodide (<math>\text{CrCl}_3 / \text{KI}</math>); FB 8 is cobalt(II) sulphate</b> |                               |   |      |     |
| 3 (a) (i)   | PDO Layout                    | Presents tests, <u>techniques</u> and observations clearly<br><i>To gain this mark there should be some reference in the table to washing at least one precipitate</i>  | [1]  | [7] |
| (ii)  | PDO                           | All observations in a single table  | [1]  |     |
| (iii)   | Recording<br>MMO<br>Decisions | Selects silver nitrate or other soluble silver salt as reagent<br>Addition of $\text{Ag}^+(\text{aq})$ or a solution containing $\text{Ag}^+$ or silver(I) ions is acceptable   | [1]  |     |
| (iv)  |                               | Uses (aqueous) ammonia with the silver halide precipitates  | [1]  |     |
| (v)   |                               | Filters or decants to obtain ppt (as soln is coloured not easy to see ppt)<br><i>Reference to separating precipitate and solution for at least one of <b>FB 6</b> or <b>FB 7</b></i>  | [1]  |     |
| (vi)  | MMO<br>Collection             | Records yellow ppt insoluble in ammonia with <b>FB 7</b> and white ppt soluble in ammonia with <b>FB 6</b>  | [1]  |     |
| (vii)   | ACE<br>Conclusions            | Uses observations to make consequential deductions as to halide ions present.<br><i>Candidates should identify <math>\text{Cl}^-</math> in <b>FB 6</b> and <math>\text{I}^-</math> in <b>FB 7</b> (no halide in <b>FB 8</b>) but mark other halides correct providing observations are completely correct for these ions<br/>If <math>\text{AgNO}_3</math> and <math>\text{Pb}(\text{NO}_3)_2</math> selected as reagents <u>only</u> points (i), (ii), (iii) and (v) can awarded</i>   | [1]  |     |
| (b)   | MMO<br>Decisions              | Selects barium chloride or barium nitrate (Addition of $\text{Ba}^{2+}(\text{aq})$ or a solution containing $\text{Ba}^{2+}$ or barium ions is acceptable] <u>and</u> hydrochloric (or nitric) acid as reagents <i>not sulphuric acid</i>   | [1]  | [3] |
|   | MMO<br>Collection             | Records white ppt with $\text{BaCl}_2$ , insoluble in acid for <u>only <b>FB 8</b> or</u><br>White ppt with $\text{BaCl}_2$ and no $\text{SO}_2$ (gas turning dichromate(VII) green) when <b>FB 8</b> tested with $\text{HCl}$ .  | [1]  |     |
|   | ACE<br>Conclusion             | Uses observations to make consequential conclusion for sulphate or sulphite if the white precipitate with $\text{BaCl}_2$ is observed to dissolve when acid is added<br><br>Marks in this section may be awarded for testing a single solution providing $\text{Ag}^+(\text{aq})$ has been added to <u>all three solutions</u> and the halides identified<br><br>If <u>sulphuric acid or an unspecified acid</u> is added after $\text{BaCl}_2$ , <b>one mark maximum</b> can be awarded in the section for a white ppt insoluble in acid. No marks if the acid is added before $\text{BaCl}_2$ | [1]  |     |

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| Question | Sections        | Indicative material  | Mark        |     |
|----------|-----------------|--|-------------|-----|
| (c)      | PDO Layout      | Tabulates observations<br><i>[This table should show clearly rows/columns for NaOH and NH<sub>3</sub> as reagents and <b>FB6/</b><b>FB7/</b><b>FB8</b>.<br/>The table does not need lines to be drawn – clearly laid out and headed blocks of text are acceptable]</i>   | [1]         | [4] |
|          | PDO Recording   | All observations reported to reagent added in excess   | [1]<br>[1]  |     |
|          | MMO Collection  | Give <b>one mark each</b> for correct observations for <u>TWO</u> of the following<br><b>FB 6</b> – (Fe <sup>3+</sup> ), <b>FB 7</b> (Cr <sup>3+</sup> ), and <b>FB 8</b> (Co <sup>2+</sup> ).<br><b>FB 6</b> – <u>red-brown/</u> (brown/rusty) ppt, insoluble in excess with both NaOH and NH <sub>3</sub> .<br><b>FB 7</b> – <u>grey-green</u> ppt with NaOH and NH <sub>3</sub> . ppt soluble in excess NaOH (to give a dark green solution) ppt insoluble in excess NH <sub>3</sub> .<br><b>FB 8</b> – blue ppt with NaOH, (possibly turning pink) or brown with excess of the reagent. The ppt is insoluble.<br>Blue ppt with NH <sub>3</sub> , expected to be insoluble in excess reagent of concentration used but (possibly dissolving to form a yellow/brown solution). | [1]         |     |
| (d)      | ACE Conclusions | Correctly identifies and gives evidence for Fe <sup>3+</sup> in <b>FB 6</b><br>Minimum evidence – red-brown ppt with NaOH and with NH <sub>3</sub><br>Cr <sup>3+</sup> in <b>FB 7</b><br>Minimum evidence – grey-green ppt with NaOH and with NH <sub>3</sub> OR<br>grey-green ppt with NaOH, soluble in excess to form a green solution   | [1]         | [2] |
|          |                 | Recognises transition metal cation from various colour changes of precipitates<br><br>Where <b>FB 8</b> is included as one of the identified ions (probably incorrectly as Cu <sup>2+</sup> ) <u>the transition metal cation may be awarded for Cr<sup>3+</sup></u> from the colour of the precipitate with NaOH and NH <sub>3</sub>   | [1]         |     |
|          |                 |  | [Total: 16] |     |