Cambridge Assessment International Education

# Cambridge International AS & A Level

**CHEMISTRY** **9701/35**

Paper 3 Advanced Practical Skills 1 **May/June 2023**

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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.



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**PUBLISHED**

## Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen). |
| GENERIC MARKING PRINCIPLE 6:<br><br>Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind. |

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**Science-Specific Marking Principles**

| | |
|---|---|
| 1 | Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly. |
| 2 | The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored. |
| 3 | Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection). |
| 4 | The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted. |
| 5 | 'List rule' guidance<br><br>For questions that require ***n*** responses (e.g. State **two** reasons …):<br><br>• The response should be read as continuous prose, even when numbered answer spaces are provided.<br>• Any response marked *ignore* in the mark scheme should not count towards ***n***.<br>• Incorrect responses should not be awarded credit but will still count towards ***n***.<br>• Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.<br>• Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science. |

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6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient ($a$) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

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| Question | Answer | Marks |
|---|---|---|
| 1(a) | **I** Table to show headings and correct units to cover all data:<br>• mass of container + **FA 2** / g or (g) or in g<br>• mass of container<br>• mass of **FA 2** correctly calculated<br>Unit: /g or (g) or in g or in grams **OR** g with each mass value<br>**AND** balance readings recorded to consistent 2 or 3 decimal places<br>**AND** volume recorded to integer value | **3** |
| | **Accuracy marks**<br>Correct volumes to the nearest integer.<br>Calculate the ratio of $^{\text{volume of gas}}/_{\text{mass of FA 2}}$ to the nearest integer for supervisor and candidates.<br>Calculate ranges of 20% and 10% of the supervisor's ratio to the nearest integer. | |
| | **II** Award if candidate's ratio ⩽ 20% range<br>**III** Award if candidate's ratio ⩽ 10% range | |
| 1(b)(i) | Correctly calculates<br>amount of $H_2$ = volume in **(a)** / 24000 mol<br>**AND** answer given to 2–4 significant figures | **1** |
| 1(b)(ii) | **M1** Shows amount of Mg as **(b)(i)**<br>**AND** use of 24.3<br><br>**M2** Correctly uses<br>% Mg = [(amount Mg in **(b)(i)** x 24.3) / mass in **FA 2**] × 100<br>**AND** answers given to 2–4 significant figures | **2** |
| 1(c) | **M1** reaction faster due to increased surface area<br>**M2** more gas escapes so percentage purity decreases<br><br>**OR**<br><br>**M1** more corrosion / more oxide layer on Mg powder due to greater surface area<br>**M2** corrosion does not produce gas / $H_2$ (with HC*l*) therefore percentage purity decreases | **2** |
| 1(d)(i) | gas / carbon dioxide leaves beaker / escapes | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 1(d)(ii) | **M1** comparison of $M_r$ between $CO_2$ and $H_2$:<br>statement that $M_r$ of $CO_2$ is much greater than ($M_r$) of $H_2$<br>**OR** 44(.0) >> 2(.0)<br><br>**M2** loss in mass is very small with hydrogen<br>**AND**<br>**either** therefore percentage error is large<br>**or** balance calibration (owtte) does not record mass loss / small changes in mass | **2** |
| 1(d)(iii) | $CO_3^{2-}(s) + 2H^+(aq) \rightarrow H_2O(l) + CO_2(g)$ | **1** |

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="3">2(a)</td><td>I All thermometer readings recorded to .0 or .5 °C<br>AND at least one at .0 and one at .5.</td><td rowspan="3">3</td></tr>
<tr><td>Accuracy marks<br>Correct all temperatures to nearest .5 °C.<br>Calculate supervisor’s greatest $\Delta T$ (= $T_{max} - T_{initial}$).<br>Calculate candidate’s $\Delta T$ at the same volume then calculate the difference, $\delta$, from the supervisor value.</td></tr>
<tr><td>II Award if $\delta \leqslant$ range A<br>III Award if $\delta \leqslant$ range B<br><table><tr><td>Supervisor $\Delta T$ / °C</td><td>$\geqslant$ 50.0</td><td>40.0 – 49.5</td><td>30.0 – 39.5</td><td>20.0 – 29.5</td><td>< 20.0</td></tr><tr><td>range A</td><td>$\pm$ 5.0</td><td>$\pm$ 4.0</td><td>$\pm$ 3.0</td><td>$\pm$ 2.0</td><td>$\pm$ 1.0</td></tr><tr><td>range B</td><td>$\pm$ 2.5</td><td>$\pm$ 2.0</td><td>$\pm$ 1.5</td><td>$\pm$ 1.0</td><td>$\pm$ 0.5</td></tr></table></td></tr>
<tr><td>2(b)(i)</td><td>M1 Temperature on y-axis and time on the x-axis<br>AND with unambiguous names or units<br><br>M2 Linear scales chosen so that the graph occupies more than half the available length for both axes<br><br>M3 All recorded points plotted accurately.</td><td>3</td></tr>
<tr><td>2(b)(ii)</td><td>M1 Two lines of best fit drawn (straight line or smooth curve) AND extrapolated<br>Any points labelled as anomalous (up to a maximum of 3 points) are ignored<br><br>M2 Correct $\Delta T$ from suitable intersect to 1 decimal place</td><td>2</td></tr>
<tr><td>2(c)(i)</td><td>Correctly calculates<br>energy = 25 $\times$ 4.18 $\times$ $\Delta T$ from (b)(ii)<br>AND answer to 2–4 significant figures</td><td>1</td></tr>
</table>

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| Question | Answer | Marks |
|---|---|---|
| 2(c)(ii) | Correctly uses<br>**M1** amount Mg = 0.40 / 24.3 = $1.65 \times 10^{-2}$ mol<br><br>**M2** $\Delta H$ = – **(c)(i)** / moles Mg<br>**AND** answer is negative and given to 2–4 significant figures | **2** |
| 2(c)(iii) | Correctly uses<br>[**(c)(ii)** / –452] $\times$ 100<br>**AND** answer to 2–4 significant figures | **1** |

| Question | Answer | Marks |
|---|---|---|
| | **FA 5** is $MgCO_3$ and **FA 6** is $FeSO_4$ and KI | |
| 3(a) | **EITHER (first method)**<br>**For carbonate ion**<br>add acid *<br>named strong acid *<br>effervescence *<br>colourless solution formed *<br>test with limewater*<br>gas / $CO_2$ gives white ppt *<br><br>**For magnesium ion**<br>using a solution *<br>add aqueous NaOH **AND** gives white ppt *<br>insoluble in excess *<br>add aqueous $NH_3$ **AND** gives white ppt **AND** insoluble in excess *<br><br>**OR (second method)**<br>**For carbonate ion**<br>heat white solid *<br>bubble gas produced through limewater *<br>white ppt formed *<br>residue is white solid *<br><br>**For magnesium ion**<br>add acid *<br>named strong acid *<br>using a solution *<br>add aqueous NaOH **AND** gives white ppt *<br>insoluble in excess *<br>add $NH_3$ **AND** gives white ppt **AND** insoluble in excess *<br><br>2 * = 1 mark (round down) | **5** |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>
<table>
<tr><th>test</th><th>observations</th></tr>
<tr><td>Test 1<br>+ NaOH(aq)</td><td>green ppt *<br>goes brown on standing*<br>insoluble in excess *</td></tr>
<tr><td>Test 2<br>+ $H_2O_2$(aq)</td><td>effervescence / bubbles / fizzing *<br>(gas / $O_2$) relights glowing splint *<br>black solid or brown solution formed *</td></tr>
<tr><td>+ starch</td><td>blue-black colour *</td></tr>
<tr><td>+ NaOH(aq)</td><td>brown ppt *</td></tr>
<tr><td>Test 3<br>+ $AgNO_3$(aq)</td><td>(pale) yellow ppt *</td></tr>
<tr><td>+ $NH_3$(aq)</td><td>(dark) green ppt *</td></tr>
<tr><td>Test 4<br>+ $BaCl_2$(aq)</td><td>white ppt *</td></tr>
<tr><td>+ $HNO_3$ (dilute)</td><td>ppt insoluble *</td></tr>
<tr><td>Test 5<br>+ acidified $KMnO_4$(aq)</td><td>purple (solution) / $KMnO_4$ turns yellow / yellow-brown / orange-brown / red-brown / brown<br>OR purple (solution) / $KMnO_4$ decolourised *</td></tr>
</table>
2 * = 1 mark (round down) (13 * available)
</td><td>6</td></tr>
<tr><td>3(b)(ii)</td><td>
<table>
<tr><th>cations</th><th>anions</th></tr>
<tr><td>$Fe^{2+}$</td><td>$I^-$</td></tr>
<tr><td>unknown</td><td>$SO_4^{2-}$</td></tr>
</table>
</td><td>3</td></tr>
</table>

| Question | Answer | Marks |
|---|---|---|
| 3(c)(i) | purple to colourless | **1** |
| 3(c)(ii) | $MnO_4^-$ + $8H^+$ + **5**$e^-$ → $Mn^{2+}$ + **4**$H_2O$ | **1** |