Cambridge Assessment International Education

# Cambridge International AS & A Level

**CHEMISTRY** **9701/34**

Paper 3 Advanced Practical Skills 2 **October/November 2021**

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 October/November 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.



© UCLES 2021

**[Turn over**

**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.

© UCLES 2021

| |
|---|
| 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. |

**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. |

© UCLES 2021

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.

© UCLES 2021

| Question | Answer | Marks |
|---|---|---|
| 1(a)(i) | **I** Constructs a single 4 × 5 table for results for 5 experiments<br>**AND**<br>at least one experiment attempted | **1** |
| | **II** Correct headings and units for data given.<br>• volume of **FB1 and** in $cm^3$ or / $cm^3$ or ($cm^3$)<br>• volume of water **and** in $cm^3$ or / $cm^3$ or ($cm^3$)<br>• time **and** in seconds or / s or (s)<br>• rate **and** / $s^{-1}$ or ($s^{-1}$) | **1** |
| | **III** All times recorded to the nearest second<br>**AND**<br>all volumes given to nearest 0.05 | **1** |
| | **IV** 3 additional volumes chosen with intervals not less than 5.00 $cm^3$<br>**AND**<br>all additional volumes of **FB 1** ⩾ 25.00 $cm^3$<br>**AND**<br>In all 3 additional experiments water is added to make a total of 45.00 $cm^3$ | **1** |
| | **V** All rates correctly calculated using 1000 / time<br>**AND**<br>**all** recorded to the same number of dp **or** same number of sf. | **1** |
| | **VI** **All five** times increase with decreasing volume of **FB 1** | **1** |
| | **VII** & **VIII** Compare ratio of time for 20.00 $cm^3$ of **FB 1** / time for 45.00 $cm^3$ of **FB 1** to 2 dp.<br><br>Award **VII** for ratio 2.10 – 2.60<br><br>Award **VIII** for ratio 2.20 − 2.50 | **2** |

© UCLES 2021

| Question | Answer | Marks |
|---|---|---|
| 1(b) | **I** Rate on y axis and volume of **FB 1** on the *x* axis<br>With correct labels **and** units.<br>Do not penalise missing / incorrect unit if penalised in **1(a) II** (ecf) | **1** |
| | **II** Linear scales chosen so that the graph occupies more than half the available length for both axes ($7 \times 5$ big squares) | **1** |
| | **III** **All** points recorded plotted correctly to within half a small square and in the correct square or on the line if it should be on the line and not on the line if it shouldn't. | **1** |
| | **IV** Draws a line of best fit.<br>This can be a straight line or smooth curve. | **1** |
| 1(c) | Rate is proportional to concentration of thiosulfate | **1** |
| 1(d)(i) | (Carbonate/ quenching bath) removes $H^+$ / neutralises acidic solution (so reaction stops). | **1** |
| 1(d)(ii) | To know when<br>all the carbonate has been neutralised / no more carbonate (solution) remains / more carbonate needs to be added<br>**OR**<br>mixture becomes acidic / pH drops below 7 / pH is no longer $\geqslant 7$ | **1** |
| 1(e)(i) | M1: moles of $H^+ = 2(.00) \times 10^{-2}$<br>**AND**<br>moles of $S_2O_3^{2-} = 4.5(0) \times 10^{-3}$<br>M2: $2(.00) \times 10^{-2} > \mathbf{2} \times 4.5(0) \times 10^{-3} / 9(.0) \times 10^{-3}$<br>Other valid methods exist (e.g., comparison of volume of acid required to react and volume used). | **2** |
| 1(e)(ii) | So acid concentration remains (almost) constant throughout the experiment<br>**OR**<br>**only** the conc of thiosulfate affects the rate. | **1** |

© UCLES 2021

| Question | Answer | Marks |
|---|---|---|
| 2(a) | M1: Unambiguous headings **and** units: / °C or (°C).<br><br>• two thermometer readings<br>• change / increase in temperature / D*T*<br><br>**AND**<br>subtraction correct.<br>M2: Both thermometer readings recorded to either 0.0 or 0.5 °C<br>M3: Award 1 mark for $15.0 \leqslant \Delta T \leqslant 35.0$ | **3** |
| 2(b)(i) | Correctly calculates $\Delta T \times 4.2 \times 40$<br>**AND**<br>answer expressed to 2 – 4 sf | **1** |
| 2(b)(ii) | M1: Shows use of<br>moles of $CuSO_4$ = ans **(b)(i)** / $(218.7 \times 1000)$<br>**OR**<br>uses<br>**(b)(i)** / (40/1000)<br>M2: Correctly uses<br>conc = **(b)(i)** / $(218.7 \times 1000) \times 0.04$<br>**AND**<br>answer expressed to 2 – 4 sf (unless already penalised in (b)(i)). | **2** |
| 2(c)(i) | Shows use of $((2 \times 0.5) / \text{temp rise}) \times 100$<br>**AND**<br>answer is correct | **1** |
| 2(c)(ii) | M1: The student is incorrect<br>**AND**<br>The temperature rise would remain the same<br>M2: The heat given out per unit volume is the same<br>**OR**<br>Although more heat is given out the volume is greater | **2** |

© UCLES 2021

| Question | Answer | Marks |
|---|---|---|
| | **FB 5** is $(NH_4)_2Fe(SO_4)_2$; **FB 6** is $NaNO_3$; **FB 7** is $NH_4Cl$ | |
| 3(a)(i) | **I** Selects (aqueous) NaOH **and / or** (aqueous) $NH_3$. | **1** |
| | **II** Selects named carbonate **or** Mg strips **or** named pH indicator | **1** |
| | **III** With **either** NaOH **or** $NH_3$:<br>green ppt<br>**AND**<br>turning brown / insoluble **in excess** | **1** |
| | **IV** Warm with NaOH<br>**AND**<br>gas / $NH_3$ that turns (damp red) litmus blue | **1** |
| | **V** With carbonate:<br>effervescence / fizzing / bubbling **OR** gas / $CO_2$ gives white ppt with limewater / limewater turns milky / chalky / cloudy white<br>With Mg: effervescence / fizzing / bubbling **OR** (gas / $H_2$) pops with a lighted splint<br>With named indicator: change to correct colour to indicate acidic solution | **1** |
| | **VI** mark for any two ions correctly identified.<br>**VI** and **VII** for all three ions correct: $NH_4^+$, $H^+$ and $Fe^{2+}$<br>Minimum evidence:<br>• green ppt **or** ppt turns brown **or** insoluble in excess with NaOH / $NH_3$ for $Fe^{2+}$<br>• fizz with Mg **or** $CO_3^{2-}$ **or** A / **or** correct final colour of indicator<br>• litmus turns blue | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(a)(ii) | M1: Selects $BaCl_2$ **or** $Ba(NO_3)_2$ followed by $HCl$ **or** $HNO_3$ (or names)<br>($H_2SO_4$ CONS both marks)<br>**OR**<br>Add either specified acid with $BaCl_2$ **or** $Ba(NO_3)_2$<br>**OR**<br>**Warm** solution with **any** named mineral acid **and** test gas with litmus paper / $(H^+)$ / $KMnO_4$ paper<br><br>M2: White ppt insoluble in (unspecified) acid<br>**OR**<br>White ppt with acidified $BaCl_2$ **or** $Ba(NO_3)_2$ (or names)<br>**OR**<br>Gas does not turn blue litmus red **or** does not decolourise $(H^+)$ / $KMnO_4$ paper<br>**AND**<br>Sulfate identified. | **2** |
| 3(b)(i) | Observations for **FB 6**<br>Melts / turns liquid *<br>Turns yellow *<br>Fizzing / effervescence *<br>Gas / $O_2$ relights glowing splint *<br><br>Observations for **FB 7**<br>Sublimation / white fumes / white smoke forms / white solid forms near top of tube *<br><br>Gas / $NH_3$ turns (red) litmus blue *<br>Gas turns (Blue) litmus red (must be in correct order) * | **3** |
| 3(b)(ii) | Thermal decomposition<br>**OR**<br>Redox | **1** |