Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/34**

Paper 3 Advanced Practical Skills 2 **October/November 2022**

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 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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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: 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: 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	<u>'List rule' guidance</u> For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • 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. • 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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Examples of how to apply the list rule
State **three** reasons … [3]

A

1	Correct	✓	**2**
2	Correct	✓	
3	Wrong	×	

B
(4 responses)

1	Correct, Correct	✓, ✓	**3**
2	Correct	✓	
3	Wrong	ignore	

C
(4 responses)

1	Correct	✓	**2**
2	Correct, Wrong	✓, ×	
3	Correct	ignore	

D
(4 responses)

1	Correct	✓	**2**
2	Correct, CON (of 2.)	×, (discount 2)	
3	Correct	✓	

E
(4 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct, Wrong	✓	

F
(4 responses)

1	Correct	✓	**2**
2	Correct	✓	
3	Correct CON (of 3.)	× (discount 3)	

G
(5 responses)

1	Correct	✓	**3**
2	Correct	✓	
3	Correct Correct CON (of 4.)	✓ ignore ignore	

H
(4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	CON (of 2.) Correct	(discount 2) ✓	

I
(4 responses)

1	Correct	✓	**2**
2	Correct	×	
3	Correct CON (of 2.)	✓ (discount 2)	

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Question	Answer	Marks
1(a)	**I the following data must be shown:** with unambiguous headings and correct units (mass of) container + **FB 2** (mass of) container (+ residue) (mass of) **FB 2** correctly calculated units: / g, (g) or g by every entry	**4**
	II all thermometer readings recorded to .0 or .5 ºC at least one reading should be .0 and at least one reading should be .5	
	III and IV award of accuracy marks check supervisor's ΔT (=$T_{max} - T_{t=2}$ from table), choose the applicable range then mark accordingly: ΔT less than 10.0 ºC: δ within 0.5 = 2 marks: δ within 1.0 = 1 mark ΔT in range 10.0–19.5 ºC: δ within 1.0 = 2 marks: δ within 2.0 = 1 mark ΔT in range 20.0–29.5 ºC: δ within 2.0 = 2 marks: δ within 3.5 = 1 mark ΔT in range 30.0–39.5 ºC: δ within 3.0 = 2 marks: δ within 5.0 = 1 mark where δ is the difference between the supervisor's and candidate's ΔT	
1(b)(i)	**M1 axes correctly labelled** temperature on *y*-axis and time on the *x*-axis **and** correct units **M2 appropriate scales** linear scales chosen so that the graph occupies, including the **extra 5 ºC** on the y-axis, more than half the available length for both axes **M3 all points recorded in table accurately plotted** if the point should be on a line, it must be on the line if the point should not be on a line, it must not be on a line the point should be in the correct small square and must be correct to within half a small square	**3**

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Question	Answer	Marks
1(b)(ii)	**M1 2 lines of best fit drawn** (straight or smoothly curved lines), one before adding **FB 2** and one for the **cooling** of the mixture **and** extrapolated to 2½ minutes so intersect is at or above the maximum thermometer reading recorded in **(a)** **and** vertical line drawn at 2½ minutes **M2 correct ΔT from the intersect at 2½ minutes** to 1 dp **and** to within 0.5 °C of examiner value	**2**
1(c)(i)	**correctly calculates** amount of $CuSO_4$ = 0.80 × 0.03 = 0.024(00) (mol) **and** answer to 2–4 significant figures (sf)	**1**
1(c)(ii)	**correctly calculates** amount of Zn = $\text{mass in } \mathbf{(a)} / 65.4$ (mol) **and** moles Zn > moles Cu^{2+} (owtte)	**1**
1(c)(iii)	**correctly calculates** heat energy = 30 × 4.18 × ΔT**(b)(ii)** (J) **and** answer to 2–4 sf	**1**
1(c)(iv)	**correct expression** $\Delta H = \mathbf{(c)(iii)} / \mathbf{(c)(i)} \times 1000$ ($kJ\,mol^{-1}$) **and** negative sign shown **and** answer given to 2–4 sf	**1**

Question	Answer	Marks
1(d)	**conclusion** **M1** ticks 3rd box **and** an explanation attempted **explanation** **M2** more (moles of) Cu^{2+} present in (old) **FB 1** (so $\Delta T \uparrow$) / solution (for old sample) is more concentrated with respect to Cu^{2+} (ora)	**2**

Question	Answer	Marks
2(a)	**I correct headings and units in Results section** • mass of crucible (+ lid) • mass of crucible (+ lid) + **FB 3** • mass of crucible (+ lid) + residue / contents / CuO • mass of **FB 3** • mass of residue units: / g, (g) or g by every entry	**4**
	II readings and subtraction • all balance readings are to 2 or 3 dp • mass of **FB 3** and residue are correctly calculated • mass of **FB 3** added is between 1.50 and 1.80 g (candidate's value)	
	III and IV award of accuracy marks award **III** mark if $\delta \leqslant \pm 0.25$ award **IV** marks if $\delta \leqslant \pm 0.10$ where δ is the difference between the supervisor's and candidate's mass ratio $=$ mass in **FB 3** / mass residue calculated to 2 dp	

Question	Answer	Marks
2(b)(i)	**correctly calculates** amount of CuO = mass of residue from **(a)** / 79.5 (mol) **and** answer given to 2–4 sf	**1**
2(b)(ii)	**correctly calculates** mass of CO_2 = mass of **FB 3** – mass of residue **and** amount of CO_2 = answer / 44 (mol) **and** answer given to 2–4 sf	**1**
2(b)(iii)	**either** • yes, **amount** / **moles** of CuO = **amount** / **moles** of CO_2 (within experimental error) (so no other decomposition product) **or** • no, **amount** / **moles** of CuO does not equal **amount** / **moles** of CO_2 (so another decomposition product formed)	**1**
2(c)	award for any possible formula of basic copper(II) carbonate which includes $CuCO_3$ **and** either one or both of $Cu(OH)_2$ and CuO e.g. $CuCO_3$•$Cu(OH)_2$, $CuCO_3$•CuO, $CuCO_3$•CuO•$Cu(OH)_2$, $CuCO_3$•CuO•2$Cu(OH)_2$	**1**
2(d)(i)	improvement: heat to constant mass (owtte)	**1**

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Question	Answer	Marks
2(d)(ii)	**M1** reagent: selects a **named** (mineral) acid or gives its correct formula **M2 o**bservation and conclusion **either** no fizzing / no reaction / no change = no carbonate (remains) / complete decomposition **or** fizzing = some carbonate remains / not fully decomposed **or** gas **/** CO_2 gives **white ppt** with limewater = some carbonate remains / not fully decomposed	**2**

Question	Answer	Marks
	FB 4 is $CuSO_4(aq)$; **FB 5** is $C_6H_{12}O_6(aq)$	
3(a)(i)	observations with **FB 4** **Test 1** + $NH_3(aq)$: • (pale) blue ppt • dark / deep blue (solution) forms (with excess) + EDTA(aq): • paler / lighter (blue) **Test 2** + EDTA(aq): • (slightly) deeper / darker (blue) + NaOH(aq): • no change / no ppt / remains blue (solution) + **FB 5** and warm: • green / yellow / brown (colour) • ppt / solid **Test 3** + Mg: • bubbles (on ribbon) • **solution** colour fades / paler blue / colourless • ribbon darkens or pink / red-brown / brown / black and solid / ppt / coating / layer on Mg	**5**

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Question	Answer	Marks
3(a)(ii)	**M1**: 'Table' with headings: 'test / experiment / reagents' and 'observations' (owtte) **and** at least 1 appropriate reagent and at least 1 observation shown **M2** and **M3**: marks are awarded using 2 • = 1 mark reagent: • selects a named (aqueous) barium salt / correct formula observation: • White ppt **either** reagent: • hydrochloric / nitric acid / HC*l* / HNO_3 (add to ppt) observation: • ppt insoluble **or** reagent: • (acidified aqueous) potassium manganate(VII) / $KMnO_4$ (add to fresh sample of solution or to mixture after addition of (aqueous) barium salt observation: • (solution / $KMnO_4$) remains purple / no change	**3**
3(a)(iii)	identifies $CuSO_4$ with evidence of sulfate from results	**1**
3(a)(iv)	$Mg(s) + Cu^{2+}(aq) \rightarrow Mg^{2+}(aq) + Cu(s)$ **or** $Mg(s) + 2H^{+}(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>observations with FB 5
<table>
<tr><th>mark</th><th>test</th><th>observation</th></tr>
<tr><td>M1</td><td>+ Tollens’</td><td>(silver) mirror / black ppt on warming</td></tr>
<tr><td>M2</td><td>+ (acidified) $KMnO_4$(aq)</td><td>pink / purple to colourless (solution) OR $KMnO_4$ decolourises (on warming)</td></tr>
<tr><td>M3</td><td>+ Na_2CO_3(aq)</td><td>no change / no bubbling</td></tr>
</table></td><td>3</td></tr>
<tr><td>3(b)(ii)</td><td>identifies aldehyde / RCHO / −CHO
and
states positive result with Tollens’ (owtte)</td><td>1</td></tr>
</table>

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