CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/32**

Paper 3 Advanced Practical Skills 2 **May/June 2025**

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 2025 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 descriptions 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.

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	‘List rule’ guidance 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.

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.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	Correct point **or** mark awarded
	Incorrect point **or** mark not awarded
	Information missing or insufficient for credit
	Benefit of the doubt given
	Contradiction in response otherwise markworthy, mark not given
	Error in number of decimal places
	Error carried forward applied
	Incorrect or insufficient point ignored while marking the rest of the response
	Benefit of the doubt not applied in this instance
	Rounding error

Annotation	Meaning
REP	Repeat error
SEEN or /	Blank page **or** part of script seen
SF	Error in number of significant figures
TE	Transcription error

Question	Answer	Marks
1(a)	**I** The following data are recorded • two burette readings **AND** titre for the rough titration • initial and final burette readings for two (or more) accurate titrations	**1**
	II Titre values recorded for accurate titrations, **AND** Correct headings and units in the accurate titration table • initial / start **AND** (burette) reading / volume • final / end **AND** (burette) reading / volume • titre **OR** volume used / added / **OR FB 2** used / added • unit: / cm^3 **OR** (cm^3) **OR** in cm^3 (for each heading) OR cm^3 unit given for each volume recorded.	**1**
	III All accurate burette readings recorded to 0.05 cm^3	**1**
	IV The final accurate titre recorded must be within 0.10 cm^3 of any other accurate titre	**1**
	Accuracy (Q) marks Round burette readings to the nearest 0.05 cm^3. Check and correct titre subtractions where necessary. Select the best mean titre, using the following hierarchy: • two (or more) accurate identical titres (ignoring any that are labelled 'rough'), *then* • two (or more) accurate titres within 0.05 cm^3, *then* • two (or more) accurate titres within 0.10 cm^3, *etc* Calculate the Supervisor's mean titre to two decimal places. Calculate the candidate's mean titre to two decimal places. Calculate the difference (δ) between the supervisor's and candidate's mean titre.	
	Award accuracy Q marks as follows: **V** Award if $\delta \leqslant 0.50\ cm^3$ **VI** Award if $\delta \leqslant .0.30\ cm^3$ **VII** Award if $\delta \leqslant 0.20\ cm^3$	**3**

Question	Answer	Marks
1(b)	Correctly calculates mean titre • Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. • Working/explanation must be shown **OR** ticks must be put next to the two (or more) accurate readings selected. • The mean should be quoted to 2 dp and be rounded to nearest 0.01 cm^3. (*e.g. 26.675 cm^3 must be rounded to 26.68 cm^3*)	**1**
1(c)(i)	Correctly uses (answer to 3 or 4 sf) **M1:** Amount citric acid in titration = $^{25}/_{1000} \times {}^{7.50}/_{192}$ **M2:** 9.766×10^{-4} mol **OR** 9.77×10^{-4} mol	**2**
1(c)(ii)	Correctly calculates Amount of NaOH used = $^{(b)}/_{1000} \times {}^{4.5}/_{40}$ mol **AND** answer to 3 or 4 sig fig	**1**
1(c)(iii)	Calculated mole ratio = $^{(c)(ii)}/_{(c)(i)}$ **OR** stated mole ratio of 2.5 ⩽ mole ratio ⩽ 3.5 **AND** results support the statement / acid is triprotic. **OR** stated mole ratio ⩽ 2.5 or ⩾ 3.5 **AND** results do not support the statement / acid is not triprotic.	**1**
1(c)(iv)	Equation $C_6H_8O_7 + 3NaOH \rightarrow C_6H_5O_7Na_3 + 3H_2O$	**1**
1(c)(v)	Any valid displayed/structural/skeletal formula containing 3 COOH groups Expected answer is $HOOCCH_2C(OH)COOHCH_2COOH$	**1**
1(d)	Student is not correct **AND** uncertainty in burette volume = 2 × 0.05 (which is greater than 0.06)	**1**

Question	Answer	Marks
2(a)	**M1** Unambiguous headings for mass, with units, correctly displayed, in **(a) AND (c)** in **(a):** • (Mass of) container + **FB 4** / g • (Mass of) container empty (or, with residue) / g • (Mass of) **FB 4** (used / added) / g **AND** value for mass of **FB 5** used in **(c)** is between 4.80 and 5.00 g **M2** Unambiguous headings for temperature, with units, correctly displayed, in **(a) AND (c)** in **(a)** • Initial temperature (or temperature of water) / °C • Final / minimum temperature / °C • Temperature change / fall / ΔT / °C in **(c)** • Initial temperature (or temperature of **FB 6**) / °C • Final / maximum temperature / °C • Temperature change / rise / ΔT / °C **M3** Precision of readings in **(a) AND (c)** • Both balance readings in (a) given to the same number of decimal places (2 or 3). • Four thermometer readings recorded to .0 or .5 °C	**3**
2(b)(i)	Correctly calculates Energy change = 30 × 4.18 × temp decrease J **AND** answer correctly rounded to 2 – 4 sf	**1**
2(b)(ii)	Correct use of **(b)(i)** **M1**: Correct display Amount of citric acid = $^{\text{mass used}}/_{192}$ mol (no answer required) **M2**: Correctly uses Enthalpy change = $^{\textbf{(b)(i)}}/_{\text{mol citric acid}} \times {}^{1}/_{1000}$ kJ mol^{-1} **AND** answer shows positive sign **AND** is quoted to 2 – 4 sf	**2**

Question	Answer	Marks
2(c)	**M1** Correct subtractions in **(a) AND (c)** • Mass of **FB 4** and **FB 5** • Two temperature changes (ignore sign)	**1**
	Accuracy (Q) marks Round thermometer readings to 0.5 °C if necessary before calculating temperature rise. If the candidate has a temp. increase in **(a) OR** a temp. decrease in **(c)**, award zero Q marks. If temperatures are clearly a factor of 10 too small, multiply by 10 before assigning marks **II** and **III**. Calculate the candidate's mass ratio (to 2dp) = temp rise in **(c)** / mass of **FB5** used	
	Award accuracy (Q) marks as follows: Award **II** if 2.75 ⩽ ratio ⩽ 3.75 Award **III** if 3.00 ⩽ ratio ⩽ 3.50	**2**
2(d)	Correct use of data in enthalpy calculation **M1** Energy change = 50 × 4.18 × temp rise in **(c)** (J) **M2** Correct use of data in remainder of calculation (all three bullets correct) • $n = \frac{\text{mass of FB 5}}{192}$ mol • $\Delta H_2 = \frac{\text{energy change}}{n \times \frac{1}{1000}}$ kJ mol^{-1} • Sign is negative **AND** answer given to 2–4 sig fig	**2**
2(e)	Enthalpy change (with correct sign) ΔH_r = **(d)** – **(b)(ii)** = $\Delta H_2 - \Delta H_1$	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FB7 is $Cu(NO_3)_2$; FB8 is $FeCl_3$</td></tr>
<tr><td>3(a)</td><td>2 * = 1 mark (round down). Max. 6 marks
2 × highlighted boxes = 1 *

<table>
<tr><th rowspan="2">test</th><th colspan="2">observations</th></tr>
<tr><th>FB 7</th><th>FB 8</th></tr>
<tr><td>Test 1 (5*)
Add an equal volume of
potassium iodide (aq),</td><td>Brown colour
(ignore state) *</td><td>Brown / red-brown solution (forms) *</td></tr>
<tr><td>then
add excess
sodium thiosulfate (aq).</td><td>white ppt (formed)*

ppt soluble in excess / solution turns colourless*</td><td>turns colourless / goes (pale) yellow / pale pink*</td></tr>
<tr><td>Test 2 (4*)
Add a small spatula measure of zinc powder. Leave the mixture to stand.</td><td>Pink / brown / black solid*

solution turns paler blue / colourless *</td><td>Fizzing / effervescence *

(gas) pops with lighted splint *</td></tr>
<tr><td>Test 3 (1*)
Add a few drops of silver nitrate (aq).</td><td>no change / no ppt / no reaction AND</td><td>ppt forms *</td></tr>
<tr><td>Test 4 (3*)
Add ammonia (aq).</td><td>(pale) blue ppt *
soluble in excess *
deep / dark blue solution formed / in excess *</td><td>brown / red-brown / rust ppt
AND insoluble in
excess (NH_3) *</td></tr>
</table></td><td>6</td></tr>
<tr><td>3(a)(ii)</td><td>FB 8 is $FeCl_3$</td><td>1</td></tr>
</table>

Question	Answer	Marks
3(a)(iii)	Tests 1 **AND** 2 (are redox)	**1**
3(a)(iv)	One equation from: • $Cu^{2+}(aq) + 2OH^{-}(aq) \rightarrow Cu(OH)_2(s)$ • $Cu^{2+}(aq/s) + 4NH_3(aq) \rightarrow [Cu(NH_3)_4]^{2+}(aq)$ • $Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$	**1**
3(b)(i)	**M1** Add (excess) NaOH to **FB 7 AND** heat **AND** add aluminium **M2** Gas / ammonia / fizzing turns (damp red) litmus blue **M3** Add (acidified) $KMnO_4$ **AND** remains purple / no change / not decolorised **OR** Add specified (dilute) mineral acid **AND** no change / no fizzing / no brown gas	**3**
3(b)(ii)	**FB 7** is $Cu(NO_3)_2$	**1**