Cambridge International AS & A Level

CHEMISTRY **9701/38**

Paper 3 Advanced Practical Skills 2 **October/November 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 October/November 2025 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

This document consists of **12** printed pages.

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	<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.

6	<u>Calculation specific guidance</u> 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	<u>Guidance for chemical equations</u> 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
BOD	Benefit of the doubt given
CON	Contradiction in response otherwise markworthy, mark not given
DP	Error in number of decimal places
ECF	Error carried forward applied
I	Incorrect or insufficient point ignored while marking the rest of the response
RE	Rounding error
REP	Repeat error

Annotation	Meaning
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** Seven unambiguous headings for readings, with correctly displayed units, in results space • (mass of) (empty) crucible / g • (mass of) crucible + **FB 1** / (hydrated) aluminium sulfate / g • (mass of) crucible and residue / contents, after 1st heating / g • (mass of) crucible and residue / contents, after 2nd heating / g • (mass of) **FB 1** / g • (mass of) residue / g • (mass of) water / mass loss / g	1
	II Four weighings in space provided • All four weighings recorded to same decimal places (either to two or to three). • Reading after 2nd heating is within +0.02 and −0.05 g of reading after 1st heating.	1
	III Correct subtractions to give masses of **FB 1**, residue and mass lost. • All masses correctly subtracted. • Mass of **FB 1** used in range 1.80 g–2.00 g (from weighings)	1
	IV and **V**: **Accuracy (Q) marks** in **(a)** Calculate candidate's mass ratio (to 2 d.p.) = $^{\text{mass } \mathbf{FB\ 1}}/_{\text{mass of residue}}$ **IV** award if ratio is in the range 1.56–2.12 (inclusive) **V** award if ratio is in the range 1.66−2.02 (inclusive)	2
1(b)(i)	Correct calculation, amount of water amount = $^{\text{mass loss}}/_{18}$ mol **AND** answer to 2–4 sf	1
1(b)(ii)	Correct calculation, amount of **FB 1** amount = $^{\text{mass of residue}}/_{\mathbf{342.3}}$ mol **AND** answer to 2–4 sf	1
1(b)(iii)	Correct use of mole ratio **x** = $^{\mathbf{(b)(i)}}/_{\mathbf{(b)(ii)}}$ **AND** answer given as closest integer	1

Question	Answer	Marks
1(c)(i)	**FB 1** / solid at start / before heating is crystalline / finely divided **AND** residue is lumpy / 'crusty' **OR** has a 'skin'	**1**
1(c)(ii)	Lid is to prevent solid / solution from spitting / frothing out.	**1**
1(c)(iii)	Student is **not** correct. **AND** mass / amount of water / lost will be lower / too low / mass **OR** amount of anhydrous (salt) will be higher / too high **OR** ratio $^{\text{mol water}}/_{\text{mol residue}}$ will be lower.	**1**

Question	Answer	Marks
2(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 3** 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 candidate's mean titre value. Calculate the supervisor's mean titre value. Calculate the difference (δ) between the candidate's mean titre and the supervisor'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
2(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 d.p. and be rounded to nearest 0.01 cm^3.	1
2(c)(i)	**M1** Shows working $^{3.48}/_{158}$ **OR** $3.48 \times {}^{\mathbf{(b)}}/_{1000}$ **OR** $^{\mathbf{(b)}}/_{1000} \times {}^{1}/_{158}$ **M2** Correctly uses amount $KMnO_4$ used = $^{3.48}/_{158} \times {}^{\mathbf{(b)}}/_{1000}$ **AND** final answer given to 3 or 4 sf	2
2(c)(ii)	$5Fe^{2+}(aq) + MnO_4^{-}(aq) + \mathbf{8}H^{+}(aq) \rightarrow \mathbf{5}Fe^{3+}(aq) + Mn^{2+}(aq) + \mathbf{4}H_2O(l)$	1
2(c)(iii)	Correct use Concentration = **2(c)(i)** $\times 5 \times {}^{1000}/_{25}$ mol dm^{-3} **AND** final answer given to 3 or 4 sf	1
2(c)(iv)	Correct use **M1** M_r of hydrated iron(II) sulfate = $^{30.00}/_{\mathbf{(c)(iii)}}$ **M2** **y** = $^{[M_r - 151.9]}/_{18}$ **AND** answer is given as an integer	2
2(d)	Student is incorrect **AND** H_2SO_4 is used in excess (so the exact volume does not matter) / H_2SO_4 / the acid is not the limiting reagent	1
2(e)	**y** will be greater **AND** one of: • lower titre • fewer moles of $KMnO_4$ • fewer moles / decreased concentration of Fe^{2+} / $FeSO_4$ • higher M_r	[1]

Question	Answer	Marks
	FB 5 is Zn; **FB 6** is $ZnSO_4$(aq); **FB 7** is $ZnCO_3$	
3(a)(i)	2 • = 1 mark **Test 1 ($FeCl_3$)** • (Solution) becomes colourless / paler yellow / pale green • Fizzing / effervescence • (Pale) green / green-white precipitate (with NaOH) • Precipitate insoluble / no change with excess NaOH / ppt / solid turns brown (at surface) **Test 2 ($CuSO_4$)** • Pink-brown **AND** precipitate / solid / residue • (Solution) gets paler (blue) **OR** (solution) turns colourless • gets hotter (or in Test 3) **Test 3 (H_2SO_4)** • Fizzing / effervescence • (Gas) pops with lighted splint • (Gas is) hydrogen	**4**
3(a)(ii)	Ammonia gives a white precipitate **AND** soluble in excess	**1**
3(a)(iii)	**FB 5** is zinc / Zn	**1**
3(a)(iv)	Copper is formed **AND** Copper ions gain electrons **OR** Copper changes oxidation state from (+)2 to 0 / Cu^{2+} changes oxidation state to 0 **OR** zinc ions formed **AND** zinc loses electrons **OR** Zinc / Zn changes oxidation state from 0 to (+)2	**1**
3(a)(v)	$Zn^{2+}(aq) + 2OH^{-}(aq) \rightarrow Zn(OH)_2(s)$	**1**

Question	Answer	Marks
3(b)(i)	2 • = 1 mark • (**FB 7** is a) white powder / solid • Condensation / water droplets • (Solid / **FB 7**) turns yellow (or yellow-green) (when hot) • Residue / solid goes paler (on cooling) **or** residue is white • Attempts to test gas with limewater • (Gas) gives white precipitate with limewater • Gas is CO_2 / carbon dioxide (evidence needed)	**3**
3(b)(ii)	**M1** Add any specified mineral acid (name **OR** correct formula) to **FB 7**. **M2** Fizzing / effervescence **AND** carbonate / CO_3^{2-}	**2**