CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **May/June 2026**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **17** printed pages.

[Turn over

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions 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
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
SEEN or /	Blank page **or** part of script seen

Annotation	Meaning
SF	Error in number of significant figures
TE	Transcription error

Mark Scheme abbreviations

/	alternative responses for the same marking point
R	reject the response
A	accept the response
I	ignore the response
ecf	error carried forward
AVP	any valid point
ora	or reverse argument
AW	alternative wording
underline	actual word given must be used by candidate (grammatical variants excepted)
( )	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks that can be given
M	marking point
ppt	precipitate
sf	significant figures

Accuracy marks must be recorded on the spreadsheet provided, on an accuracy grid or on a blank part of the Supervisor's script. If using a spreadsheet or accuracy grid, this must be printed and stapled inside the Supervisor script. The relevant Supervisor results must be written and ringed on **each candidate script**.

When awarding the accuracy (Q) mark in **Question 2**, record:

- candidate's number
- candidate's mass
- candidate's mass residue
- mark awarded

When awarding accuracy marks in **Question 3** record:

- candidate titre
- difference from supervisor, δ
- mark awarded
- any adjustment (spread adjustment (SA), 50-adjustment (50-A) or rough titration adjustment (RTA))

In either question, where more than half the candidates score no marks against the supervisor value, **please contact your team leader (TL)**.

Practical issues at a centre sometimes mean that candidates cannot access all of the marks. In such cases, contact your TL. Candidate marks may need to be scaled.

Reject <u>either</u> a rounding error (RE) <u>or</u> a transcription error (TE) only once in the paper. Note: Reject REs <u>only</u> in 'correctly calculates'. Reject fractions in place of decimal answers only once in the paper.

Restarts: In calculations sections of quantitative analysis questions, candidates may gain credit in a question part by using either a previous incorrect answer **or** they may 'restart' the calculation using their experimental data correctly. Annotate either 'ecf' or 'allow: restart'.

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>**FA 1** is $MnCl_2$; **FA 2** is $Al_2(SO_4)_3$</td><td></td><td></td></tr>
<tr><td>1(a)(i)</td><td>Table of expected observations.
Maximum mark available = 6

<table><tr><th>test</th><th>observation</th></tr><tr><td>**T1** + NaOH(aq)</td><td>off-white / buff / beige / (light / pale) brown ppt *
insoluble in excess / ppt
darkens / turns brown *</td></tr><tr><td>+ H^+ / $KMnO_4$(aq)</td><td>$KMnO_4$ decolourised / loses purple colour *
(forms) dark / darker brown / brown-black **ppt** *</td></tr><tr><td>+ H_2O_2(aq)</td><td>effervescence / fizzing / bubbling *
relights glowing spill *</td></tr><tr><td>**T2** + NH_3(aq)</td><td>off-white / buff / beige / (light / pale) brown ppt *
insoluble in excess / ppt
darkens / turns brown *</td></tr><tr><td>**T3** + $AgNO_3$(aq)</td><td>white ppt *</td></tr><tr><td>+ NH_3(aq)</td><td>off-white / buff / beige / (light / pale) brown ppt *</td></tr></table></td><td>**6**</td><td>Award one blob (*) for each correct answer.
2 blobs = 1 mark: round down (14* available).
Write ticks on script. No. of marks = No. of ticks.

<table><tr><th>test</th><th>observation</th></tr><tr><td>**T1**</td><td>**I** cream ppt **R** yellow / yellow-brown.
If brown ppt initially then it must be a darker brown on standing.
If both observations made both must be correct e.g. **R** ‘ppt soluble in excess’ and ‘turns brown’.</td></tr><tr><td></td><td>**A** purple turns **ppt** to dark brown.
R purple turns brown.
R red-brown ppt.
I black (alone) ppt (in 2nd or 3rd box).</td></tr><tr><td></td><td>**R** gas produced.
A splint glows brighter.
R a second gas test with a positive result.</td></tr><tr><td>**T2**</td><td>**A** cream ppt if 2nd time seen.
R yellow / yellow-brown / grey ppt.</td></tr><tr><td>**T3**</td><td>**R** off-white / cream ppt.</td></tr><tr><td></td><td>**A** cream ppt if **I** (ignored) previously.
A yellow-brown if third time seen.</td></tr></table></td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1(a)(i)</td><td>
<table>
<tr><td>T4 + Na_2CO_3(aq)</td><td>white ppt / off-white / buff / beige / light / pale brown ppt*</td></tr>
<tr><td>+ HNO_3</td><td>effervescence / fizzing / bubbling *
colourless solution forms / ppt dissolves *
gas tested with limewater and gas / CO_2 forms white ppt in limewater *</td></tr>
</table>
</td><td></td><td>
<table>
<tr><td>T4</td><td>I milky / cloudy (for ppt).
R (white) ppt soluble in excess.</td></tr>
<tr><td></td><td>R gas produced.
I solution turns colourless A ppt disappears.
R milky / cloudy (ppt with limewater).
R if any other gas test with positive result.</td></tr>
</table>
</td></tr>
<tr><td>1(a)(ii)</td><td>Ions are Mn^{2+} and Cl^-</td><td>1</td><td>A Br^- ecf if first ppt seen in Test 3 was described as off-white or cream. R Cl^- in this case.
A Mn^{+2}.</td></tr>
<tr><td>1(a)(iii)</td><td>One correct ionic equation:
$Mn^{2+} + CO_3^{2-} \rightarrow MnCO_3$
$CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$</td><td>1</td><td>Mark ecf to cation identified in 1(a)(ii) (provided it forms an insoluble carbonate).
A Mn^{+2} / CO_3^{-2}.
I state symbols.</td></tr>
<tr><td>1(a)(iv)</td><td>Precipitate caused by Mn^{2+} ions
and
the ppt masks solubility of the (white) ppt in NH_3 (owtte)</td><td>1</td><td>A ecf from incorrect cation in 1(a)(ii) (provided it forms a ppt with NH_3).
A cation / Mn^{2+} / manganese(II) ion forms a ppt with NH_3 in Test 2, so result is unreliable.
I ammonia is used to identify cations too / test is used for both anions and cations.</td></tr>
</table>

Question	Answer	Marks	Guidance
1(b)(i)	**M1 Layout mark:** single 'table' with two headings: reagent / test (owtte) and observations / results **and** NaOH **or** NH_3 **or** barium ions used with attempt at observation **M2** NaOH / (aqueous) sodium hydroxide added **and** white precipitate **and** ppt soluble in excess **M3** NH_3 / (aqueous) ammonia added **and** white ppt **and** ppt insoluble in excess **M4 BaC*l*$_2$ or Ba(NO$_3$)$_2$ /** added **and** white precipitate formed **M5 Add HC*l* or HNO$_3$** to the white ppt **and** ppt **not** soluble (in acid) / no change / ppt remains **OR** **Add (acidified) potassium manganate(VII) / KMnO$_4$** (to **FA 2 or** to ppt) **and** no change / ($KMnO_4$) **stays** / **remains** purple / pink	**5**	**A** two tables if one for the cation tests and one for the anion tests. **R** individual tests and results. **I** additional tests / reagents for **M1**. For **M2 – M5** reagents must be given their full names or correct formulae. Award 'rescue' mark **M3** for two white ppts if both alkalis are used **and** excess reagents not used in either test. **I** additional test with (aqueous) sodium carbonate. If halide or nitrate ions were tested for (using $AgNO_3$ or NaOH + A*l*) **M4 cannot** be awarded (but **M5** can). **R** addition of H_2SO_4 (CON **M5**). **A** potassium permanganate **R** MnO_4^-. **R** incorrectly shown formula e.g.eg $KmNO_4$. **A** does not decolourise $KMnO_4$. **R** mixture / ppt / solution **turns** purple / pink. If test with both acid and $KMnO_4$ then both observations must be correct. **A** addition of hydrochloric or nitric acid before adding barium chloride or nitrate and no visible reaction (*so not thio*): white ppt with (aqueous) barium chloride / nitrate gains **M4** and **M5**. **A M5** for adding a named acid **without Ba^{2+}** being used if the observation is no ppt / no reaction (H_2SO_4 is allowed in this case) **R** 'fizzing'.
1(b)(ii)	A*l*$_2$(SO$_4$)$_3$	**1**	Stand-alone provided at least one test attempted for a cation and at least one test for an anion.

Question	Answer	Marks	Guidance
2(a)	**M1**: **Unambiguous headings and correct units** to cover 7 entries • (mass of) crucible (and lid) • (mass of) crucible (and lid) **and FA 3** / hydrated salt • (mass of) crucible (and lid) **and** contents / residue after first heating • (mass of) crucible (and lid) **and** residue / contents after second heating • (mass of) **FA 3** / hydrated salt • (mass of) residue / anhydrous salt • mass loss / mass of water Unit for all seven pieces of data recorded: (g), / g, in g **M2: Four readings in space provided** • All four weighings recorded consistently either to 2 or to 3 decimal places (dp) • Fourth reading is within + 0.02 and − 0.05 g of third reading. **M3**: **Three correct subtractions** to give masses: • Mass of residue (answer, with heading) • Mass loss correctly subtracted (with heading). • Mass of **FA 3** used in range 2.10 g – 2.40 g (from weighings)	**4**	Lid can be included or omitted, provided this is done consistently. Third and fourth readings must be distinguished. e.g. 'contents' then 'residue' (as Method) / 'first residue' then 'second residue'. **A** after cooling. **A** on heating / cooling **1 and** on heating / cooling 2. **I** 'mass of residue after 1st heating'. **R** '**FA 3**' used in third and fourth readings, but **A** 'anhydrous **FA 3**' instead of 'residue'. **A** in grams, / grammes **R** gram, gr, / (g), (/g). **R** weight for mass. **R** incorrect **display** of units only once per paper. **A** if a named salt or formula shown in **1(b)(ii)** is given in place of **FA 3**. **A** correct heading for third heating. **R** if **any** readings are impossible: (e.g. 3rd weighing is lower than the 1st **or** greater than the 2nd). **A** 4 – dp balance. **R** 1 – dp balance unless lack of 2 – dp balances is recorded in the supervisor's report. Check that the mass of residue claimed by student is **not** the mass loss. If 4th weighing > 3rd weighing, candidate may use either value but examiner must use lower value for **M4**. **A** from figures written against relevant instruction in the method. **I** figures from **2(b)**.

Question	Answer	Marks	Guidance
2(a)	**Examiner re-reads supervisor report to check whether the centre had to substitute a different hydrated salt.** Examiner checks subtractions for supervisor and calculates $\frac{\text{mass FA 3}}{\text{(genuine) mass of residue}}$ correct to 2 dp. This value is written and ringed on each candidate script. Calculate a ± 10.0% range of the supervisor's value (to 2 dp). This range appears on the spreadsheet or must be entered on the accuracy grid for the centre. Check the candidate's subtractions and calculate $\frac{\text{mass FA 3}}{\text{mass of residue}}$ correct to 2 dp. Write this value next to the ringed value. If candidates (and supervisor) carried out a third heating then use the mass of residue calculated from this value.		
	M4: **Accuracy (Q) mark** in **2(a)** Award **M4** if candidate ratio is within the 10.0% of the supervisor's value. Default values: Award **M4** if ratio ($Al_2(SO_4)_3$•16 H_2O) is within the range 1.66 – 2.02 ($Al_2(SO_4)_3$•18 H_2O: 1.75 – 2.15; $ZnSO_4$•7 H_2O: 1.60 – 1.96)		For the Q mark, masses can be inferred by examiner from table or from working in part **2(b).** **Use default only if fewer than 50% score vs supervisor and more score vs default.** Value for ratio using $Al_2(SO_4)_3$•16 H_2O = 1.84. (Value for ratio using $Al_2(SO_4)_3$•18 H_2O = 1.95) (Value for ratio using $ZnSO_4$•7 H_2O = 1.78) Use the same method for determining the accuracy mark for any other hydrated compound given in the supervisor's **report**, e.g. $Al_2(SO_4)_3$•15 H_2O and check with your TL.
2(b)(i)	**Correctly calculates** amount of water = mass loss / 18 mol **and** answer given to 2–4 significant figures (sf)	**1**	Mass loss may be calculated from weighings **or** from mass of **FA 3** and mass of residue. Expected answer = approx 0.055 mol. Do not reject incorrect sf more than once in **2(b)**. **R** if data recorded on page 5 does not allow mass loss to be calculated.
2(b)(ii)	**Correctly calculates** M_r of anhydrous **FA 3** = 342.3 [Default: $Ba(NO_3)_2$ = 261.3]	**1**	The '0.3' must be shown **or** as part of an A_r string. **A** ecf from incorrect formula of aluminium sulfate from **1(b)(ii)**. **A** ecf from any **valid** formula of a Group 2, zinc or aluminium compound given in **1(b)(ii)**. (e.g. M_r: $ZnSO_4$ = 161.5; $MgSO_4$ = 120.4; $BaSO_4$ = 233.4) **A** use of default in place of M_r of $Al_2(SO_4)_3$ even if **FA 2** identified.

Question	Answer	Marks	Guidance
2(b)(iii)	**Correctly calculates** amount of residue = mass residue / **(b)(ii)** mol **and** answer given to 2–4 sf [Default, n(residue) = mass residue / 261.3 mol]	**1**	expected answer = approx 0.0035 ($Al_2(SO_4)_3$•16 H_2O) (using / 342.3) [expected answer = approx 0.0046] (default). **A** ecf from any value given in **2(b)(ii).** **R** if no mass of residue or figures giving rise to mass of residue recorded on page 5. Do not penalise sf if already penalised in **2(b)(i).**
2(b)(iv)	**Correctly uses** amount of water = **(b)(i) / (b)(iii)** mol **and** formula = $Al_2(SO_4)_3$•16 H_2O (expected answer)	**1**	Some working must be shown. **A** ecf for the formula shown in **1(b)(ii)** with the appropriate integer value for H_2O from the calculation [Expected answer for barium nitrate = approx 12] **R** non – integer value **R** if integer is incorrect from value calculated but (in this case only) allow .5 to be round either way.
2(c)(i)	**Correct expression** required For 2-dp balance: uncertainty = 0.005 g % error = (2 × 0.005 / mass of **FA 3**) × 100 For 3 – dp balance: uncertainty = 0.0005 g % error = (2 × 0.0005 / mass of **FA 3**) × 100 **and** answer correctly evaluated	**1**	The '2' must be shown or implied as working The '100' can be inferred from answer **R** uncertainty of 0.01 g for 2 – dp. and 0.001 g uncertainty for 3 – dp balance. (4 – dp balance: uncertainty = 0.00005 for single reading) (1 – dp balance: uncertainty = 0.05) If uncertainty is given correctly then allow (0.01 / mass of FA 3) (for 2 dp balance), etc.
2(c)(ii)	(If crucible is nearly full) spitting / frothing out of solid is more likely **or** More difficult to drive out **all** the **water** **or** it would take much longer to heat to **constant mass**	**1**	**A** it would need longer (time) heating to lose **all** the water / become completely anhydrous. **I** hydrated salt may not decompose completely. **I** the reaction may not go to completion (in the time allocated).

Question	Answer	Marks	Guidance
3(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	**7**	Headings and units are **not** required for this mark Rough titration readings may be labelled in the accurate table. **I** errors in values for rough titration, e.g. an initial reading of 50, incorrect subtractions, etc.
	II Titre values recorded for accurate titrations, **and correct headings and units** in a single **accurate** titration table • initial/start **and** (burette) reading/volume • final/end **and** (burette) reading/volume • titre **or** volume used/added/ **or FA 7** used/added • unit: /cm^3 **or** (cm^3) **or** in cm^3 (for each heading) **or** cm^3 unit given for each volume recorded.		**R** if initial and final burette readings do not match the data. **R** if not a single table. **A** 'vol' or 'V' or 'value' for 'reading / volume'. **R** 'difference' or 'amount' or 'change' or 'titrate' (titre) **I** 'total' (titre). **R** ml / cc. **I** 'titre' instead of 'titration' as an overarching heading e.g. 'titre 1', 'titre 2'. **A** incorrectly displayed units if already penalised in **2(a).** **A** correctly displayed unit in overarching heading.
	III All accurate burette readings recorded to 0.05 cm^3		**R** if: • 50(.00) is used as an initial burette reading • More than one final burette reading is 50(.00) • Any burette reading is greater than 50(.00). The requirement to record to 0.05 applies to burette readings, including 0.00 cm^3 (if this was the initial reading), but it does not apply to the **titre.**

Question	Answer	Marks	Guidance
3(a)	**IV** The **final** accurate titre recorded must be within 0.10 cm^3 of any other accurate titre		**I** any reading labelled rough. **R** if these titres are derived from **any** burette readings recorded as integers (apart from initial 0 cm^3).
	Accuracy (Q) marks Round burette readings to the nearest 0.05 cm^3. Check and correct titre subtractions where necessary. Examiner selects 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 difference (δ) between the candidate's mean titre and the supervisor's mean titre Write and ring supervisor's value next to the accurate titration table for each candidate. Also write the candidate's mean value (calculated by examiner) and difference between supervisor's and candidate's value, δ.		
	Award accuracy Q marks as follows: **V** Award if $\delta \leqslant 0.60\ cm^3$ **VI** Award if $\delta \leqslant 0.40\ cm^3$ **VII** Award if $\delta \leqslant 0.20\ cm^3$		If an **adjustment** is applied: **V** Award if $\delta \leqslant 0.40\ cm^3$ **VI** Award if $\delta \leqslant 0.20\ cm^3$ **VII** Not available A **spread adjustment** (SA) is required if titres selected (by examiner) differ by 1.00 cm^3 A**50 – adjustment**(50 – A) is required if 50.(00) is used as initial volume. Use mean of final volume **or** actual titre (whichever gives a better Q score). A **rough titration adjustment** (RTA) is required if **only** a rough titration was carried out. Use the rough titre to award Q marks. If only **one** accurate titration was carried out, use it assess Q marks a normal. **A** bod for accuracy marks from titre values with no readings shown. For supervisor's mean titre $\leqslant 10.00\ cm^3$: 3 marks: 0.10; 2 marks: 0.20; 1 mark: 0.30 cm^3. For supervisor's mean titre $\leqslant 5.00\ cm^3$: 3 marks not available, 2 marks: 0.10; 1 mark: 0.15 cm^3. Adjustments apply as above.

Question	Answer	Marks	Guidance
3(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**	Do **not** award this mark if: • The rough titre was used to calculate the mean. • The candidate did only one accurate titration. • Burette readings were incorrectly subtracted to obtain **any** of the accurate titre values. • All burette readings used to calculate the mean were recorded as integers. **A** mean expressed to 1 dp, if **all** accurate burette readings were given to 1 dp and the mean is exactly correct. e.g. if titres are 26.0 and 26.2: mean = 26.1 is correct e.g. if titres are 26.0 and 26.1: mean = 26.1 is wrong (should be 26.05 cm^3). **A** from no burette readings and only titre values given.
3(c)(i)	All answers to parts **3(c)(ii)**, **(c)(iv)** and **(c)(v)** are given to 3 or 4 significant figures.	**1**	All three answers are needed for this mark. **A** answers not shown on the answer line provided they are clearly the final answers.
3(c)(ii)	**Correct calculation** Amount of KOH used = 10.0 / 56.1 × 25 / 1000 = 0.004456 / 0.00446 mol	**1**	**A** 4.5×10^{-3} or full calculator value if sf **R** in **(c)(i).** **R** if .1 not shown unless already rejected in **2(b)(ii).** **R** 0.00445 as **RE** unless RE already incurred.
3(c)(iii)	$H_2SO_4(aq) + 2\,KOH(aq) \rightarrow K_2SO_4(aq) + 2\,H_2O(l)$	**1**	**A** $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$. **R** if no, incomplete or incorrect state symbols given. **A** multiples ($2\,H^+(aq) + 2\,OH^-(aq)$ etc.).
3(c)(iv)	**Correct use** Concentration = 0.5 x **(c)(ii)** × 1000 / **(b)** mol dm^{-3}	**1**	**A** ecf for a 1:1 ratio if an equation has been attempted expected answer = approx 0.10 mol dm^{-3}.
3(c)(v)	**Correct use** Mass of H_2SO_4 = 250 / 25 × **(c)(iv)** × 98.1 g	**1**	Expected answer = approx 100 g. **A** absence of '.1' as ecf if 56 (instead of 56.1) rejected in **3(c)(ii)** or in **2(b)(ii)**.

Question	Answer	Marks	Guidance
3(d)	**M1** M_r of NaOH < M_r of KOH (**or** reference to A_r values) **and** alkali NaOH is more concentrated (than KOH) **M2** titre is greater / greater volume of **FA 7** (required / used) **and** concentration of H_2SO_4 calculated is lower (than **(c)(iv)**)	**2**	**A** amount of NaOH is greater as it has lower M_r (needs concentration mentioned for **M1**). **A** there are more moles of NaOH in the aliquot / 25 cm^3 used in the titration (for concentration). **R** NaOH is a stronger base than KOH. **R** NaOH is more reactive. **R M2** if there is **no** correct mention of A_r / M_r / concentration in **M1** but award **M2** only e.g.: M_r of NaOH < M_r of KOH so moles in **(c)(ii)** much lower than reality. This would mean concentration of **FA 7** is actually lower in part **(c)(iv)**. **A** for 1 mark: the concentration of sulfuric acid is lower as sodium hydroxide is more concentrated (than potassium hydroxide).