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International Education

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CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills 1 **February/March 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.

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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.

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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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Question	Answer	Marks
1(a)	**I** Six unambiguous headings for balance readings **AND** calculated values **AND** correct units • (mass of) crucible (and lid) • (mass of) crucible (and lid) and **FA 1** • (mass of) crucible (and lid) and residue / contents after first heating • (mass of) crucible (and lid) and residue / contents after second heating • (mass of) **FA 1** • (mass of) residue • Units: / g, (g), in g (or g with every entry) **II** Recording of all weighings • All four weighings recorded to same number of decimal places (two or three). • Fourth reading is within +0.02 and –0.05 g of third reading. **III** Correct calculation of masses Correct masses of **FA 1** and residue **AND** both answers to min 2 sf. **Accuracy marks** Calculate candidate's mass ratio (to 2 d.p.) = mass **FA 1** / mass of residue. **IV** award if ratio is within the range 1.70–2.00 (inclusive) **V** award if ratio is within the range 1.80–1.90 (inclusive)	**5**
1(b)(i)	Correct calculation of amount of water amount of H_2O = (mass of **FA 1** – mass of residue) / 18 **AND** answer to 2–4 s.f.	**1**

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Question	Answer	Marks
1(b)(ii)	Correct use of amount of water amount of potassium alum, **FA 1** = **(b)(i)** / 12 **AND** answer to 2–4 s.f.	**1**
1(b)(iii)	Correct use of amount of anhydrous potassium alum M_r of anhydrous alum = mass of residue / **(b)(ii)** **AND** answer to 2–4 s.f.	**1**
1(b)(iv)	Formula is $Al K(SO_4)_2$ **AND** (correct) working which shows use of **(b)(iii)** **AND** use of 27(.0) **or** 258.3.	**1**
1(c)(i)	Correct expression (Uncertainty **U** (for 2 d.p. balance) = 0.01) % error in weighing **FA 1** = $^{2 \times U}$ / $_{\text{mass of residue}} \times 100$ **AND** answer given.	**1**
1(c)(ii)	If anhydrous potassium alum decomposes: mass loss will be higher / too high **OR** no longer is only water lost **OR** (calculated) moles of water / **(b)(i)** will be higher **AND** (calculated) amount / moles of residue / (anhydrous) potassium alum / **(b)(ii)** will be higher / too high. *(*so M_r of residue / **(b)(iii)** will be too low).	**1**

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Question	Answer	Marks
2(a)	**I** All 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. **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 FA 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. **III** All accurate burette readings recorded to 0.05 cm^3. **IV** The final accurate titre recorded must be within 0.10 cm^3 of any other accurate titre.	**7**
	Accuracy marks Round burette readings to the nearest 0.05 cm^3 then 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.* The 'best' titres should be used to calculate the mean titre, expressed to the nearest 0.01 cm^3. Calculate the supervisor's mean titre to 2 decimal places. Calculate the candidate's mean titre to 2 decimal places. Calculate the difference δ between the candidate's titre and the supervisor's titre.	
	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	

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Question	Answer	Marks
2(b)	Correct calculation of the 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)	answers to parts **(c)(ii), (c)(iii) and (c)(iv)** are given to 3 or 4 significant figures.	**1**
2(c)(ii)	Correct calculation of amount of sodium thiosulfate amount of sodium thiosulfate used = $^{22.0}/_{248.2} \times {}^{\text{titre}}/_{1000}$	**1**
2(c)(iii)	Correct use of (c)(ii) amount I_2 = 0.5 × **(c)(ii)**	**1**
2(c)(iv)	Correct calculation of amount of **FA 3** amount **FA 3** = $0.0175 \times {}^{25}/_{1000}$ = 0.0004375	**1**
2(c)(v)	Correct use of (c)(iii) and (c)(iv) amount I_2 = $^{\textbf{(c)(iii)}}/_{\textbf{(c)(iv)}}$ **AND** answer to 1 decimal place.	**1**
2(c)(vi)	**M1** Working to show increase in oxidation state for I (during reaction) = **(c)(v)** × (+)2 **M2 M** changes from (2 + **M1**) to (+) 2 **AND** both values are integers	**2**
2(d)	Student is incorrect **AND** **FA 5** / sulfuric acid is used in excess (so the exact volume does not matter).	**1**

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Question	Answer	Marks
	FA 3 is $KMnO_4$ **FA 7** is $(NH_4)Fe(SO_4)_2 + H_2SO_4$	
3(a)	**Test 1** • (with NaOH) no change **OR** (solution) stays / remains purple • (with Na_2SO_3) green <u>solution</u> (formed at first) / (solution) <u>turns</u> green • (with Na_2SO_3) brown ppt / solid • (with acid) turned / formed **AND** colourless (solution). **Test 2** • Purple <u>turns</u> colourless **OR** colourless <u>solution</u> formed • Fizzing / effervescence **Test 3** • fizzing / effervescence • (dark) brown solid / ppt forms • (gas) re-lights glowing spill • gas is O_2 Two points needed for each mark, to a maximum of 4 marks.	**4**

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Question	Answer	Marks
3(b)(i)	**Test 1** • (with NaOH) brown / red-brown / rust <u>precipitate</u> • (with NaOH) insoluble in <u>excess</u> (NaOH) • (on warming) <u>gas</u> / NH_3 turns (red) litmus blue • (with A*l*) fizzing / effervescence **Test 2** • (with KI) (solution) turns darker yellow / yellow-brown / orange-brown / red-brown / brown (with starch) turns dark blue / blue-black / black **Test 3** • fizzing / effervescence (gas / H_2) gives pop with lighted splint **Test 4** • (with Ba^{2+}) white precipitate • (with HC*l*) ppt remains / insoluble • (with HC*l*) yellow <u>solution</u> formed **Test 5** • (with $AgNO_3$) no change / no precipitate • (with NH_3) brown / red-brown / rust precipitate • (with NH_3) insoluble in excess Two points needed for each mark, to a maximum of 6 marks.	**6**
3(b)(ii)	Correct identification of ions H^+, NH_4^+, Fe^{3+}, SO_4^{2-} 4 ions correct = 2 marks 2 or 3 ions correct = 1 mark	**2**

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Question	Answer	Marks
3(b)(iii)	One correct ionic equation: $Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$ $NH_4^{+}(aq) + OH^{-}(aq) \rightarrow NH_3(g) + H_2O(l \text{ or } g)$ $Mg(s) + 2H^{+}(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$ $Mg(s) + 2Fe^{3}(aq) \rightarrow 2Fe^{2+}(aq) + Mg^{2+}(aq)$	**1**

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