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CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701 / 34**

Paper 3 Advanced Practical Skills 2 **October/November 2024**

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 2024 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.

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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	‘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.

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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** 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	**1**
	II Correct headings and units shown in the **accurate** titration table and **titre values** recorded for accurate titrations • initial / start **and** (burette) reading / volume • final / end **and** (burette) reading / volume • titre **or** volume / **FB 2 and** 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 are recorded to the nearest 0.05 cm^3.	**1**
	IV: The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre	**1**
	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 Supervisor's mean titre > 50.00 cm^3 then use the tolerances (0.80, 0.50, 0.30 cm^3) If Supervisor's mean titre < 10.00 cm^3 then halve the tolerances (0.30, 0.20, 0.10 cm^3) If Supervisor's mean titre < 5.00 cm^3 then use the tolerances (0.15, 0.10, 0.05 cm^3)	**1**
1(b)	**Correctly calculates the mean titre to 2 decimal places.** • Candidate must take the average of two (or more) accurate 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. (e.g. 26.675 cm^3 must be rounded to 26.68 cm^3).	**1**

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Question	Answer	Marks
1(c)(i)	Answers to **all 3** parts of **(c)(ii)** and **(c)(iii)** quoted to 3 or 4 significant figures.	**1**
1(c)(ii)	**M1: Correctly calculates** amount of $S_2O_3^{2-}$ = **(b)** / 1000 × 0.0100 (1) **M2: Correct use of n($S_2O_3^{2-}$)** amount of I_2 = ans / 2 × 150 / 25 (1)	**2**
1(c)(iii)	**Correct use of** amount of I_2 from **(c)(ii)** / 0.150 **or** (**M1** from **(c)(ii)** / 2) × (1000 / 25)	**1**
1(c)(iv)	**M1: Correctly calculates** 0.05(00) **and correctly uses** (0.0500 – **(c)(iii)**) / 80 **M2: Units** mol dm^{-3} s^{-1}	**2**
1(d)	Release of iodine from the starch complex is slow at high iodine concentrations **Or** A starch-iodine complex / precipitate is formed which does not decompose (during the titration)	**1**
1(e)	The student is incorrect **and** one of: • The sodium hydrogencarbonate must be added at 80 s to stop / quench the reaction (by reacting with the acid catalyst) ORA • The reaction would continue if the sodium hydrogencarbonate is not added at 80 s • The sample can be removed before 80 s as the reaction only stops when the sodium hydrogencarbonate is added. • The sodium hydrogencarbonate reacts with the acid which is the catalyst.	**1**

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Question	Answer	Marks
2(a)	**I 4 unambiguous headings for balance readings and correct units** • (Mass of) crucible + lid • (Mass of) crucible, lid and **FB 4** (or 'contents before heating') • (Mass of) crucible, lid and contents / residue after first heating • (Mass of) crucible, lid and contents / residue after second heating Units with **all** required headings: / g, (g), in g (or g with every entry)	**1**
	II Recording of all weighings • All 4 weighings recorded to same number of decimal places (two or three). • Fourth weighing is within +0.02 and –0.05 g of third weighing.	**1**
	III Calculated masses Correct subtractions to give masses of **FB 4** and residue **and** both headings clearly labelled **and** both answers to min 2 sf.	**1**
	For assessment of accuracy (Q) marks Calculate the candidate's mass ratio (to 2 d.p.) = mass **FB 4** / mass of residue. If 4th weighing > 3rd weighing, use lower value to calculate the mass of residue.	
	Award accuracy Q marks as follows: Award **IV** if 1.07 ≤ ratio ≤ 1.27 Award **V** if 1.12 ≤ ratio ≤ 1.22	**2**

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Question	Answer	Marks
2(b)	**M1 Correctly calculates amount of water** amount of H_2O = (mass of **FB 4** – mass of residue) / 18 **and** answer to 2–4 s.f. **M2 Correct use of amount of water** M_r of MA_2 = 2 × mass of residue / amount of H_2O **and** answer to 2–4 s.f.	**2**
2(c)	**Identification of A^-** • use of (aqueous) silver nitrate / $AgNO_3$ • white precipitate formed • precipitate is soluble in (excess aqueous) ammonia • **A^-** is identified as Cl^- / chloride	**2**
2(d)	**Identification of M^{2+}** Shows working: (**(b)** – 71) **and** selects **M** from Group 2 with closest A_r **and** 2+ charge on ion	**1**
2(e)	**M1** (Calculated) M_r would be greater **and** amount / moles of water is smaller **or** mass of residue / **MA_2** is greater	**1**
	M2 One of: • there are significant / big differences between the A_r s of the elements / metals (in Group 2) owtte • most of the water was driven off / very little water of crystallisation left owtte • the calculated A_r (or M_r) is **still** closest to the same answer	**1**

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Question	Answer	Marks
Q3 FB 6 is $KMnO_4$; FB 7 is $CuSO_4(aq)$		
3(a)(i)	2* = 1 mark • (Dark) purple / purple-black solid / crystals (initially) • (Solid / crystals) jump(s) around the tube / pops / crackles (on heating) • Black powder / solid / residue (remains) • (gas) relights a glowing splint • (gas produced is) oxygen	**1**
3(a)(ii)	**Test 1** (forms) purple solution **Or** (water) turns purple (solution)	**1**
	Test 2 (forms) green solution **or** (NaOH) turns green (solution)	**1**
3(a)(iii)	thermal decomposition / redox	**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
<table>
<tr><th>Test</th><th>Observations</th></tr>
<tr><td>1
+NH_3</td><td>(pale) blue ppt *
(ppt) soluble / disappears in excess (NH_3)
or solution formed in excess (NH_3) *
Deep / dark blue (solution) (with excess) *</td></tr>
<tr><td>+ H_2O_2</td><td>black / (dark) green*
effervescence*
(gas) relights a glowing splint*</td></tr>
<tr><td>2
+ KI</td><td>brown / yellow-brown / yellow solution*
(off-)white / (pale) brown / yellow-brown
precipitate / solid*</td></tr>
<tr><td>+
$Na_2S_2O_3$</td><td>Solution / solid / ppt becomes paler owtte*
Precipitate partially dissolves or ppt dissolves in excess (thiosulfate)*</td></tr>
</table></td><td>5</td></tr>
<tr><td>3(b)(ii)</td><td>M1 Choice of reagent(s)
Selects barium chloride / $BaCl_2$ or barium nitrate / $Ba(NO_3)_2$
and nitric acid / HNO_3 or hydrochloric acid / HCl
OR
Selects (acidified aqueous) potassium manganate(VII) / (H^+) & $KMnO_4$</td><td>1</td></tr>
<tr><td></td><td>M2 Clear results to show:
white ppt (with Ba^{2+}) and insoluble in acid
OR
($KMnO_4$) remains purple / not decolourised / no change</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>$CuSO_4$</td><td>1</td></tr>
</table>

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