



Cambridge International AS & A Level

CHEMISTRY**9701/34**

Paper 3 Advanced Practical Skills 2

October/November 2023

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 2023 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.

PUBLISHED**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 descriptors 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.

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Question	Answer	Marks
1(a)	I Constructs a single table on page 4 for results of experiments to include the 4 items of required data and results to show at least 2 experiments completed.	9
	II Correct headings and units for recorded data given: • volume of FB 1 given as (cm³), / cm³, in cm³ or cm³ after each entry • volume of water given as (cm³), / cm³, in cm³ or cm³ after each entry • time given as (s), / s, in seconds or s after each entry • rate given as (s⁻¹), / s⁻¹ or s⁻¹ after each entry	
	III All times recorded to the nearest second (minimum of 3 experiments) and volumes of FB 1 and water recorded to .#0 or .#5 cm ³	
	IV Three additional volumes chosen with intervals not less than 2.00 cm ³ and all volumes of FB 1 ≥ 5.00 cm ³	
	V In all three additional experiments water is added to make the same total volume of FB 1 + H ₂ O (20 cm ³).	
	VI All rates correctly calculated using 1000 / time and given to 2–4 significant figures and either to the same number of significant figures or decimal places.	
	VII All 5 times increase with decrease in volume of FB 1 .	
	Examiner calculates the ratio of (time for expt 2 / time for expt 1) to 2 dp for candidate.	
	VIII Award if the ratio is between 1.20 and 1.80 IX Award if the ratio is between 1.30 and 1.60	

Question	Answer	Marks
1(b)	I Rate on <i>y</i>-axis and volume (of FB 1) on <i>x</i>-axis and axes clearly labelled with unambiguous names or units and some numbers for scales. II Linear scales based on 1, 2 or 5 and include the origin and scale chosen so that the point plotted for 20 cm³ FB 1 is <u>more than</u> halfway along each axis. III All recorded points plotted correctly to within half a small square and in the correct square and minimum of 4 experiment points plotted. IV Draws a smooth curved line of best fit.	4
1(c)	Curved line: Rate is <u>not</u> proportional to concentration (of FB 1) or as concentration of FB 1 increases the rate increases	1
1(d)(i)	Correctly calculates amount of Fe ³⁺ = (0.020 × 0.0500) = 1.00 × 10 ⁻³ mol and answer to 2–4 significant figures.	1
1(d)(ii)	Correctly calculates amount of I ⁻ = (0.010 × 0.0500) = 5.00 × 10 ⁻⁴ mol and answer to 2 – 4 significant figures.	1

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Question	Answer	Marks
1(d)(iii)	Correct use of (d)(i) and (d)(ii) to calculate amount of I_2 = (d)(ii) / 2 ($= 2.50 \times 10^{-4}$ mol) and answer to 2–4 significant figures.	1
1(d)(iv)	Correct use of (d)(iii) to calculate concentration of $Na_2S_2O_3$ M1 (d)(iii) $\times$ 2 ($= 5.00 \times 10^{-4}$) M2 ((d)(iii) $\times$ 2 / 0.020) ($= 0.0250$ mol dm $^{-3}$) and answer to 2–4 significant figures.	2

Question	Answer	Marks
2(a)	I Six unambiguous headings recorded, with correctly displayed units and in the space provided. Units: (°C), / g, in g, or °C or g against each value • (Mass of) container + FB 5 / contents / solid / g • (Mass of) (empty) container (+ residue) / g • (Mass of) FB 5 / Na₂A•5H₂O / solid used / g • (Initial) temperature (of water) / °C • minimum / final temperature (of solution) / °C • Temperature change / decrease / ΔT / °C II Precision of readings. Two weighings to same number of decimal places (2 or 3) and two thermometer readings to .0 or .5 °C and appropriate to the headings given. III Correct subtractions for mass of FB 5 and ΔT and Mass of FB 5 between 3.50 and 4.50 g IV Accuracy mark Examiner calculates ΔT / mass to 2 dp for candidate. IV Award if ΔT / mass is between 1.40 and 1.85.	4
2(b)(i)	Correct calculation of energy change Energy change = $20 \times 4.18 \times \Delta T$ (= $83.6 \times \Delta T$) and answer correctly rounded to 2–4 sf	1
2(b)(ii)	Correctly uses ans (b)(i) / 47400 and answer given to 2–4 sf	1

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Question	Answer	Marks
2(b)(iii)	Correct display of M_r = mass in (a) / ans (b)(ii) and [mass in (a) / ans (b)(ii)] –136 and a final answer shown.	1
2(c)	Student is <u>incorrect</u> as temp change/ decrease is smaller.	1

Question	Answer	Marks
FB 6 = ZnCO_3; FB 7 = HCl and HNO_3 Check for capital and lower case letters in formulae; reagents must be complete (not just ions); check for missing charges and state symbols in ionic equation and charges within formulae of solid compounds.		
3(a)	Observations: 2* = 1 mark (round down).	4
	Test 1 condensation / droplets of water / steam / water vapour* (solid) goes yellow (on heating)* (solid returns to) white on cooling*	
	Test 2 fizzing / effervescence / bubbles* solid dissolves or (colourless) solution formed* vigorous / strong / rapid reaction / fizzing or (tube / solution) becomes warm*	
	In either Test 1 or Test 2 : gas / CO_2 tested with limewater* (either on heating or adding acid.) gives white ppt*	
3(b)(i)	M1 uses NH_3 / ammonia.	2
	M2 white ppt and soluble in excess	
3(b)(ii)	Zn^{2+} and CO_3^{2-}	1

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Question	Answer	Marks
3(c)(i)	M1 HCl : AgNO_3 and white ppt	4
	M2 HNO_3 : NaOH and Al and warms / heats M3 fizzing / effervescence / gas / NH_3 / fumes turns litmus blue	
	M4 H_2SO_4 : BaCl_2 / $\text{Ba}(\text{NO}_3)_2$ and no change / no ppt	
3(c)(ii)	HCl and HNO_3	1
3(c)(iii)	One from: $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$ $3\text{NO}_3^-(\text{aq}) + 8\text{Al}(\text{s}) + 5\text{OH}^-(\text{aq}) + 18\text{H}_2\text{O}(\text{l}) \rightarrow 8\text{Al}(\text{OH})_4^-(\text{aq}) + 3\text{NH}_3(\text{g})$	1

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Alternative MS for 3(a) and 3(b) if candidates have been supplied with CaCO_3 rather than ZnCO_3 because a centre could not get hold of ZnCO_3 . This part of the MS would apply to a complete centre, not individual candidates.

Question	Answer	Marks
FB 6 = CaCO_3; FB 7 = HCl and HNO_3 Check for capital and lower case letters in formulae; reagents must be complete (not just ions); check for missing charges and state symbols in ionic equation and charges within formulae of solid compounds.		
3(a)	Observations: 2* = 1 mark (round down).	4
	Test 1 no change when heated (owtte) / (solid) remains white* white residue / solid (after cooling)*	
	Test 2 fizzing / effervescence / bubbles* solid dissolves or (colourless) solution formed* vigorous / strong / rapid reaction / fizzing or (tube / solution) becomes warm*	
	Gas test in Test 2 only: gas / CO_2 tested with limewater* (either on heating or adding acid) gives white ppt*	
3(b)(i)	M1 uses NH_3 / ammonia and NaOH	2
	M2 NaOH: white ppt and insoluble in excess And NH_3: no change / no reaction / no ppt	
3(b)(ii)	Ca^{2+} and CO_3^{2-}	1