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Cambridge Assessment International Education

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.

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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 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.

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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** 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 (cm^3), / cm^3, in cm^3 or cm^3 after each entry • volume of water given as (cm^3), / cm^3, in cm^3 or cm^3 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** $\geqslant$ 5.00 cm^3	
	V In all three additional experiments water is added to make the same total volume of **FB 1** + H_2O (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	

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Question	Answer	Marks
1(b)	**I** Rate on *y-axis* and volume (of **FB 1**) on *x-axis* **and** axes clearly labelled with unambiguous names or units **and** some numbers for scales.	**4**
	II Linear scales based on 1, 2 or 5 **and** include the origin **and** scale chosen so that the point plotted for 20 cm^3 **FB 1** is more than 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.	
1(c)	Curved line: Rate is not 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+} = $(0.020 \times 0.0500) = 1.00 \times 10^{-3}$ mol **and** answer to 2–4 significant figures.	**1**
1(d)(ii)	**Correctly calculates** amount of I^- = $(0.010 \times 0.0500) = 5.00 \times 10^{-4}$ 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 (= 2.50×10^{-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 (= 5.00×10^{-4}) **M2** (**(d)(iii)** $\times$ 2 / 0.020) (= 0.0250 mol dm^{-3}) **and** answer to 2–4 significant figures.	**2**

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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** / Na_2**A**•$5H_2O$ / solid used / g • (Initial) temperature (of water) / °C • minimum / final temperature (of solution) / °C • Temperature change / decrease / ΔT / °C	**4**
	II Precision of <u>readings</u>. 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.	
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**

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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: $BaCl_2$ / $Ba(NO_3)_2$ **and** no change / no ppt	
3(c)(ii)	HCl **and** HNO_3	**1**
3(c)(iii)	One from: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ $3NO_3^-(aq) + 8Al(s) + 5OH^-(aq) + 18H_2O(l) \rightarrow 8Al(OH)_4^-(aq) + 3NH_3(g)$	**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** =HC*l* 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 in**soluble in excess **And** NH_3: no change / no reaction / no ppt	
3(b)(ii)	Ca^{2+} **and** CO_3^{2-}	**1**