Cambridge Assessment International Education

Cambridge Pre-U

CHEMISTRY **9791/04**

Paper 4 Practical **May/June 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 May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

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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.

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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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

Examiners are reminded that these instructions and the Mark Scheme are **STRICTLY CONFIDENTIAL**.

1 Refer to the ***Instructions to Examiners*** booklet for details of all procedures.

2 Make sure that you have read and understood the mark scheme and the question paper for this component. The decisions of the **Principal Examiner** are final, and the final agreed mark scheme must be applied as intended by the Principal Examiner.

3 Please report any serious problems during marking to your **Principal Examiner** (details in the confidential package)

4 For support relating to the examination process, contact the **CIE Examiner Helpdesk** (01223 553500).

MARKING

1 The schedule of dates is very important. It is essential that you meet the Batch 1 and Batch 2 deadlines. If you experience problems, you must contact your PE or Product Manager without delay.

2 Mark in red. Do not use any other colour.

3 Put tick alongside the correct answer. One tick = one mark. Use ✓✓ or ✓✓✓ when necessary.

4 Put sub-totals at the end of each subsection next to the square-bracketed mark. Put ringed totals at end of each question.

5 Add up ticks and cross-check with sub-totals and ringed totals. Remember it is the number of ticks that determines the final mark.

6 Transfer marks for each question to the front of the paper and total them. Cross-check.

7 Mark strictly to the mark scheme. All marks awarded must relate directly to the marking criteria.

8 If you are in any doubt about applying the mark scheme, consult your PE by telephone or by email.

9 Mark schemes will use these abbreviations:

;	separates marking points
/	alternatives
ORA	or reverse argument
ALLOW	for a non-ideal but allowable alternative valid point
NOT	answer is not credited
underline	actual word underlined must be used by candidate (grammatical variants excepted)
(xxx)	wording in brackets is for the clarity of the mark scheme but is not required
max	indicates the maximum number of marks that can be given
+ or **AND**	statements on both sides of the + or AND are needed for that mark
ECF	error carried forward
IGNORE	for an answer that is not creditworthy but does not invalidate any additional creditworthy response

10 Work crossed out:
(a) where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no credit
(b) if a candidate crosses out an answer and makes no further attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

11 Watch for context and scientific correctness. A correct phrase should be discounted if contradictory or incorrect associations are later made within the same response, not just the same sentence. Wrong science that is irrelevant to the question should be ignored.

12 Do not select correct answers from lists that include wrong points. To guard against a scattergun approach an incorrect item in a list, where more than the required number of items are given, is counted as a contradiction (e.g. where 3 points are needed and 5 are given, 2 of which are incorrect, only one is scored).

13 For correct answers not provided for in the mark scheme, give as far as possible equivalent marks for equivalent work. For answers given outside the syllabus content give credit for correct, relevant science. If in doubt, consult your PE, and inform your PE of any answers you think should be included on the published mark scheme.

14 Spellings of syllabus terms that could be ambiguous must be correct (e.g. sulphate/sulfite; nitrate/nitrite, propane/propene, ethanol/ethanal; ethanoic/ethanolic).

15 Spellings of syllabus terms that are clear and not ambiguous can be accepted if phonetically correct (e.g. fenolfalene).

16 Do not penalise grammatical constructions/spelling of words that are not in the syllabus, so long as the meaning is clear.

17 Mark all the candidate's responses wherever they have been written (including blank pages, around diagrams, etc. and in other (usually adjacent) responses as agreed at coordination. Tick the marks where they have been earned, and indicate that the marks have been transferred to the subtotal by the question e.g. with a strike-though arrow and the page or question number.

18 When making a judgement, make a clear indication or comment as to why a mark has or has not been awarded so that anyone who subsequently looks at the script, for whatever purpose, can see your reasoning

19 Do NOT write anything on the script that you or CIE would not want to be seen by a candidate or Centre.

20 Standard annotations include the following.

Annotation	Meaning
✓	1 mark given
BOD	Benefit of doubt
NBOD	Benefit of doubt NOT given
CON	Answer is contradictory and no mark has been awarded
ECF	Error carried forward in numerical answers
^	Omission sign / caret mark: the answer is incomplete
SEEN	Response seen but no credit given

Question	Answer	Marks
1(a)	**I** records clearly a volume between 24.00 and 26.00 cm^3 (1)	
	II tabulates initial burette readings, final burette readings and volume of **FA 2** added (1)	
	III appropriate headings and units for titration results; in cm^3 **or** (cm^3) **or** / cm^3 (1)	
	IV all accurate burette readings and the volumes of **FA 2** added are given to the nearest 0.05 cm^3 (1)	
	V two or more uncorrected titres within 0.20 cm^3 (1)	
	VI, **VII, VIII** examiner calculates using ratio = corrected titre / volume used for dilution to 2 decimal places δ = supervisor ratio – candidate ratio award **VI, VII** and **VIII** if $\delta \leqslant 0.01$ award **VI** and **VII** only if $\delta \leqslant 0.02$ award **VIII** only if $\delta \leqslant 0.03$ (3)	**8**
1(b)	selects titres within 0.20 cm^3, calculates the correct mean and gives answer to the same number of decimal places as the most precise burette reading	**1**
1(c)(i)	shows correct working ans**(b)** / 25.0 × 0.1 (1)	**1**
1(c)(ii)	correctly calculates: **(c)(i)** × 250 / vol of **FA 1** used. (1)	**1**
1(d)	shows use of 2 × 0.05 or 0.10 (1) correctly calculates: **(c)(ii)** × (vol used) / (vol used – 0.10) (1)	**2**
1(e)(i)	white ppt (1)	**1**
1(e)(ii)	HCl **AND** (the anion of) the weak acid does not form an insoluble salt / ppt (1)	**1**

Question	Answer	Marks
2(a)	unambiguous headings for each entry with temperature in °C **AND** all temperatures recorded to at least 0.5 °C (1)	
	compare ΔT to supervisor award if $\delta \leqslant 1.0$ °C (1)	**2**
2(b)(i)	shows use of $\Delta T \times 4.2 \times 45$ (1) in calculating the answer: $\Delta T \times 4.2 \times 45 / 1000$	**1**
2(b)(ii)	shows use of **1(c)(ii)** $\times$ 20 (1) calculates **1(c)(ii)** $\times$ 20 / 1000 $\times$ 57.9 (1)	**2**
2(b)(iii)	amount of H^+ from the weak acid: shows use of **(b)(i)** – **(b)(ii)** / 56.1 (1) calculates the concentration of the weak acid: [**(b)(i)** – **(b)(ii)**] / 56.1 $\times$ 1000 / 20 (1)	**2**
2(c)	any two pairs of assumptions and tests assumption: the NaOH is in excess / all the acid reacts (1) test: calculate to check that this is the case or measure the pH of the mixture or test with carbonate or named indicator (1) assumption: **FA 1** and **FA 4** have the same starting temperature (1) test: measure temperature of **FA 4** (1) assumption: values for the enthalpy change of neutralisation apply in these conditions (1) test: Measure the temperature rise for solutions with known concentrations and compare to calculated values (1)	**4**
	FA 5 = $NaNO_2$; **FA 6** = $FeSO_4$; **FA 7** = Na_2CO_3; **FA 8** = $BaCl_2$	

Question	Answer	Marks
3(a)(i)	Results with sodium hydroxide **FA 5**: no visible reaction **FA 6**: green ppt turning brown (on contact with air) **FA 7**: no visible reaction **FA 8**: no visible reaction all correct (1) Results with dilute nitric acid **FA 5**: brown gas **FA 6**: no visible reaction **FA 7**: effervesence / fizzing **FA 8**: no visible reaction all correct (1) Results with acidified aqueous $KMnO_4$ **FA 5**: decolourise **FA 6**: decolourise **FA 7**: no change / stays purple **OR** effervesence **FA 8**: white ppt all correct (1)	**6**

Question	Answer	Marks
	results with silver nitrate then ammonia **FA 5**: white ppt (●) soluble (●) **FA 6**: no visible reaction (●) dark green / black ppt (●) **FA 7**: white ppt (●) insoluble **FA 8**: white ppt (●) soluble (●) 6 ● scores (2) 4 or 5 ● scores (1) Results with **FA 8** **FA 5**: no visible reaction **FA 6**: white ppt **FA 7**: white ppt all correct (1)	
3(a)(ii)	**FA 5** contains NO_2^- **FA 6** has Fe^{2+} **FA 6** has SO_4^{2-} **FA 7** has CO_3^{2-} **FA 8** has Cl^- all 5 correct (3) 3 or 4 correct (2) 1 or 2 two correct (1)	**3**
	FA 9 = $AlCl_3$; **FA 10** = $ZnCl_2$	
3(b)(i)	NaOH: observes white ppt soluble in excess for **FA 9** (1) white ppt soluble in excess for **FA 10** (1) NH_3: observes white ppt insoluble in excess for **FA 9** (1) white ppt sol in excess for **FA 10** (1)	**4**

Question	Answer	Marks
3(b)(ii)	**FA 9** contains Al^{3+} **AND** **FA 10** contains Zn^{2+} (1)	**1**