Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/36**

Paper 3 Advanced Practical Skills 2 **October/November 2021**

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 2021 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.

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.

Question	Answer	Marks
1(a)	**I** Unambiguous headings 2 balance readings **and** mass of **FB 1** correctly calculated **and** correctly displayed units	**1**
	II The following data must be shown • burette readings **and** titre for rough titration • 2 × 2 'box' showing both accurate burette readings	**1**
	III Headings and units correct for accurate titration table and headings match readings. • initial / start **and** (burette) reading / volume + unit • final / end **and** (burette) reading / volume + unit titre **or** volume / **FB 4 and** used / added + unit	**1**
	All accurate burette readings are recorded to the nearest 0.05 cm^3	**1**
	The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**
1(a)	**VI, VII and VII:** Award **V** for a range of 15% of the supervisor value for M_r Award **VI** for a range of 10% of the supervisor value for M_r Award **VII** for a range of 5% of the supervisor value for M_r If the supervisor titre is ≤ 10.00 cm^3 then halve tolerances (0.10, 0.15, 0.25). If supervisor titre & candidate titres ≤ 5.00 cm^3 contact TL	**3**
1(b)	Candidate must average two (or more) accurate titres with total spread of not more than 0.20 cm^3. Working must be shown or ticks must be put next to the two (or more) accurate readings selected. The mean should be correctly calculated to the nearest 0.01.	**1**
1(c)(i)	**All** answers in **(c)(iii)**, **(c)(iv)** and **(c)(vi)** given to 3 or 4 sf	**1**
1(c)(ii)	Correctly calculates moles of HC*l* added: 0.800 × (50 / 1000) = 0.0400	**1**

Question	Answer	Marks
1(c)(iii)	Correctly calculates mol of NaOH used: **(b)** × (0.1 / 1000) **and** moles of HC*l* remaining = moles of NaOH × 10	**1**
1(c)(iv)	Correct expression **(d)(iv)** = **(c)(ii)** – **(c)(iii)**	**1**
1(c)(v)	$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$ **OR** $Na_2CO_3 \cdot \mathbf{x}H_2O(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + (\mathbf{x} + 1)H_2O(l) + CO_2(g)$	**1**
1(c)(vi)	Correctly uses **(c)(iv)** / 2	**1**
1(c)(vii)	Correctly uses M_r = m / n = mass of **FB 1** from **(a)** / **(c)(vi)**	**1**
	Correct expression **x** = (M_r – 106) / 18 **and** expressed to the nearest integer **or** to 2–4 sf	**1**
1(d)	0.05 or 0.1 if 1 dp balance used / 0.005 or 0.01 if 2 dp balance used / 0.0005 or 0.001 if 3 dp balance used **and** Correct expression {(2 × error above) / mass from **(a)**} × 100	**1**
1(e)	Titre would be smaller **and** More acid has reacted in Step 1 / less acid remaining after reaction in Step 1	**1**

Question	Answer	Marks
2(a)	**I** Unambiguous headings and correct units: • (mass of) crucible and lid • (mass of) crucible and lid and contents (before heating) / **FB 5** • (mass of) **FB 5** • (mass of) crucible and lid and residue / contents (after heating) • (mass of) residue / contents (after heating) • (mass of) mass lost during heating / water Units: (g), / g, in grams	**1**
	II All weighings recorded to same number of decimal places **and** All calculations of mass correct **and** matching headings	**1**
	III Accuracy (Q) mark • Examiner must check and correct (if necessary) the masses of **FB 5** used and of residue (smaller mass) obtained by supervisor and by candidate. • Calculate [(mass of **FB 5**) / (mass of residue)] for the supervisor to 2 dp • Write this ratio, in a ring, on the candidate script • Calculate [(mass of **FB 5**) / (mass of residue)] for the Candidate to 2 dp • Calculate d, the difference between these two ratios Award **III** if d $\leqslant$ 0.20	**1**
2(b)	Correct calculation of moles of: anhydrous sodium carbonate (mass of residue / 106) **and** water (mass lost / 18)	**1**
	y found by calculation of moles of water / moles of sodium carbonate **and** answer expressed to nearest integer value or to 2–4 sf	**1**
2(c)	Heat to constant mass / use larger initial mass of **FB 5** / use a balance that reads to more dp	**1**

Question	Answer	Marks
3	**FB 6** is MnO_2 **FB 7** is $FeSO_4$ **FB 8** is NH_4Cl	
3(a)(i)	Test 1 Effervescence * (gas / O_2) relights a glowing splint *	**1**
	Test 2 Filtrate / solution is green * filtrate after addition of acid is purple / pink *	**1**
	Test 3 solution turns yellow / yellow-brown * + NaOH brown / red-brown ppt * fizzing (in either part) *	**1**
	Test 4 White ppt * insoluble in acid / no (visible) change *	**1** **1**
	Test 5 Solid sublimes / white solid forms further up the test tube / solid disappears / white smoke / white fumes / no residue * Gas / NH_3 turns red litmus blue * (On further heating) gas turns blue litmus red *	**1**
	Test 6 White ppt * ppt dissolves *	**1**
3(a)(ii)	**FB 6**: unknown **FB 7**: SO_4^{2-} / sulfate **FB 8**: Cl^- / chloride All three correct: 2 marks any two correct: 1 mark	**2**

Question	Answer	Marks
3(b)	**I** Table or clear display of reagents, results and conclusions for minimum of 2 tests attempted	**1**
	II Correct results: **FB 7**: green ppt **and** ppt insoluble in excess / turning brown on standing	**1**
	III Heats **FB 8** with NaOH **and** gas / NH_3 turns (red) litmus blue	**1**
	IV FB 7 = Fe^{2+} **and** **FB 8** = NH_4^+	**1**
3(c)(i)	**FB 7** acts as a reducing agent / **FB 7** is oxidised **and** **FB 7** / Fe^{2+} is oxidised / changes to Fe^{3+} / red-brown ppt shows Fe^{3+} / red-brown ppt forms / H_2O_2 is an oxidising agent / $Fe^{2+} - e^- \rightarrow Fe^{3+}$ **OR** **FB 7** acts as a catalyst **and** rate of decomposition increases	**1**
3(c)(ii)	Any one of: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$	**1**