Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/36**

Paper 3 Advanced Practical Skills 2 **October/November 2020**

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 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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.

Rounding errors and transcription errors are penalised only once in the paper.

Question	Answer	Marks
1(a)	**I** Unambiguous headings in layout of weighings **and** correct mass of **FB 1** added **and** units correct: / g, (g) or in gram(me)s Reject 'weight'	**1**
	II Unambiguous recording of volume of CO_2 with correct unit	**1**
	III Volume of gas collected is in the range 120−240 cm^3 Allow gas volume from **(b)(i)** if not recorded in **(a)** Note: if more than one expt. has been performed then **all** volumes collected must be within the limits above	**1**
1(b)(i)	Correctly calculates $\frac{\text{V}\textbf{(a)}}{24.0 \times 1000}$ **and** answer given to 2–4 sf	**1**
1(b)(ii)	Correctly uses $\frac{\text{mass } \textbf{FB 1} \text{ from } \textbf{(a)}}{\textbf{(b)(i)}}$ **and** answer given to 2–4 sf	**1**
1(b)(iii)	Correct expression $\frac{\textbf{(b)(ii)} -138.2}{18}$ Note: 138.2 or 39.1 must be seen Allow expression to be shown in two (or more) steps	**1**
	x given as correct integer from candidate's expression	**1**

Question	Answer	Marks
1(c)	Any 2 of the following: • Heat water (before collecting gas) • Saturate water with CO2 (before collecting gas) • Collect the gas over a (dilute) strong acid / any non-alkaline solution / use more concentrated acid in flask	**2**

Question	Answer	Marks
2(a)	**I** Headings and units Data set out in horizontal / vertical lines / columns showing • 2 × mass of container + solid / **FB 3** / **FB 4** • 2 × mass of container (+ residue) • 2 × initial thermometer reading / temperature • 2 × highest / lowest / final thermometer reading / temperature • 2 × mass of solid (used / added) / **FB 3** / **FB 4** • 2 × ΔT / change in temperature Units: / g, (ºC), in gram(me)s Reject 'weight' unless already penalised in **1(a)** Note: data must be included but not necessarily correct.	**1**
	II All four balance readings recorded to the same number of dp **and** thermometer readings recorded to .0 °C or .5 °C **and** written in the table Reject if all temperatures are below 10.0 °C	**1**
	III Correctly calculates 2 × mass of solid 2 × change in temperature (ignore sign) Allow from **2(b)(i)** and **2(b)(ii)** if correctly calculated	**1**
	Examiner checks subtractions of supervisor and candidate. *Write supervisor values (ringed) on the candidate script and calculate the differences, δ, from candidate.*	

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>Award IV, V (Expt 1) and VI, VII (Expt 2) according to the table.

<table>
<tr><td>Supervisor ΔT</td><td>5.0–10.0 °C</td><td>< 5.0 °C</td></tr>
<tr><td>1 mark</td><td>δ = 1.5 °C</td><td>δ = 1.0 °C</td></tr>
<tr><td>2 marks</td><td>δ = 1.0 °C</td><td>δ = 0.0 °C</td></tr>
</table></td><td>4</td></tr>
<tr><td>2(b)(i)</td><td>Correctly calculates
Q (heat energy) = $25 \times 4.2 \times \Delta$T for both experiments and answers to 2–4 sf

Allow ecf from incorrect ΔT
Ignore signs
Do not penalise incorrect sf more than once in (b)</td><td>1</td></tr>
<tr><td>2(b)(ii)</td><td>Correctly uses
$\frac{(25 \times 4.2 \times \Delta T) \times 106}{\text{mass } \mathbf{FA\,3} \times 1000}$ | $\frac{(25 \times 4.2 \times \Delta T) \times 286}{\text{mass } \mathbf{FA\,4} \times 1000}$
One mark awarded for each correct calculation.</td><td>2</td></tr>
<tr><td></td><td>Correct signs shown and answers given to 2–4 sf</td><td>1</td></tr>
<tr><td>2(b)(iii)</td><td>Attempt at use of Hess' law / energy level diagram / reverse equation
Note: minimum display of working is correct direction of arrows and correct numbers shown / equations labelled and correct numbers shown)</td><td>1</td></tr>
<tr><td></td><td>Correctly uses
$\Delta H_1 - \Delta H_2$ and correct sign and answer to 2–4 sf

(Default answer = – 72.9)</td><td>1</td></tr>
<tr><td>2(c)</td><td>No effect and same number / moles / amount / concentration of hydrogen ions</td><td>1</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FB 6 is $Na_2CO_3(aq)$; FB 7 is $CrCl_3(aq)$; FB 8 is $FeSO_4(aq)$</td></tr>
<tr><td>3(a)(i)</td><td>14 observations. Two * = 1 mark (round down)
<table>
<tr><th></th><th>FB 6</th><th>FB 7</th><th>FB 8</th></tr>
<tr><td>+ NH_3</td><td>no (visible) reaction / no change / no ppt *</td><td>grey-green ppt and insoluble in excess *</td><td>green ppt and insoluble in excess / turns brown *</td></tr>
<tr><td>+ H_2SO_4</td><td>effervescence / bubbling / fizzing *
limewater test attempted *
gas / CO_2 turns limewater milky / cloudy white / forms white ppt *</td><td>no (visible) reaction / no change *
ignore no ppt</td><td>no (visible) reaction / no change *
ignore no ppt</td></tr>
<tr><td>+ H^+ / MnO_4^-</td><td>purple remains / no reaction / no change / purple not decolourised *
fizzing *
(limewater test and observation may be awarded here)</td><td>purple remains / no reaction / no change / purple not decolourised / turns darker purple *</td><td>purple / MnO_4^- and decolourised / solution turns yellow *</td></tr>
<tr><td>+ FB 6</td><td></td><td>green ppt *
ignore excess
allow white- green / grey-green ppt
(limewater test and observation can be awarded here)</td><td>(pale) green ppt *
ignore excess
ignore turning brown</td></tr>
</table></td><td>7</td></tr>
</table>

Question	Answer	Marks
3(a)(ii)	Carbonate **or** hydrogen carbonate identified from correct formula	**1**
	$2H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$ Allow $H^+(aq) + HCO_3^-(aq) \rightarrow H_2O(l) + CO_2(g)$	**1**
3(a)(iii)	All three correct = 2 marks, 2 correct = 1 mark **FB 6** = unknown (Ignore Na^+) **FB 7** = Cr^{3+} **FB 8** = Fe^{2+} Allow unknown **and** chromium(III) **and** iron(II) for 1 mark	**2**
3(b)(i)	Uses $AgNO_3$(aq) for halides **and** $Ba(NO_3)_2$(aq) / $BaCl_2$(aq) for S-anion **OR** $AgNO_3$ then NH_3 for halide (any named halide) **OR** $Ba(NO_3)_2$(aq) / $BaCl_2$ followed by HCl / HNO_3 for S-anion (sulfate and sulfite) Allow $Ba(NO_3)_2$(aq) / $BaCl_2$ then (separate test) (acidified) $KMnO_4$ for S-anion (sulfate and sulfite) Allow without state symbols. Ignore separate test of adding acid (test for carbonate). Ignore addition of HNO_3 before adding $AgNO_3$.	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(ii)</td><td>Clear presentation in a ‘table’ of results to show FB 7 and FB 8 and two or more reagents.
Note: the reagents need not be correct for this mark to be awarded
Note: no observations are needed for this mark to be awarded</td><td>1</td></tr>
<tr><td></td><td>6 observations. 2 * = 1 mark (round down)

<table>
<tr><td>test</td><td colspan="2">observation</td></tr>
<tr><td></td><td>FB 7</td><td>FB 8</td></tr>
<tr><td>+ Ag^+</td><td>white ppt •</td><td>(slowly forms) (pale) brown ppt •
allow no change</td></tr>
<tr><td>+ NH_3</td><td>ppt turns grey-green / green ppt *
Reject ppt dissolves</td><td>ignore</td></tr>
<tr><td>+ Ba^{2+}</td><td>no reaction / no change •</td><td>white ppt •</td></tr>
<tr><td>+ H^+ to ppt OR</td><td>ignore</td><td>ppt insoluble •</td></tr>
<tr><td>(allow) + $KMnO_4$ to soln.</td><td>ignore</td><td>purple to colourless / yellow – as (a)(i) *</td></tr>
</table>

Ignore observations for any other reagents</td><td>3</td></tr>
<tr><td>3(b)(iii)</td><td>Both ions correct = 1 mark
FB 7 = Cl^-
FB 8 = SO_4^{2-}

Ignore names of ions</td><td>1</td></tr>
</table>