Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

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.

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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.

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Question	Answer	Marks
1(a)	Unambiguous recording of volume of gas, 2 balance readings to same dp and correct mass of **FA 2** used. Units as /cm^3 or (cm^3) and / g or (g).	**1**
	Volume of gas within range 0.9 – 1.1 × supervisor volume	**1**
	Volume of gas within range 0.8 – 1.2 × supervisor volume	**1**
1(b)(i)	Correctly calculates moles = vol of gas / 24 000 AND answer given to 2 – 4 sf	**1**
1(b)(ii)	Correct use of M_r = $\frac{\textit{mass from (a)}}{\textit{(b)(i)}}$	**1**
	Use of 60	**1**
	Correct (from candidate's value of M_r) A_r and correct to 2 to 4 sf Be ⩽ 16.65; 16.65 ⩽ Mg ⩽ 32.10; 32.10 ⩽ Ca ⩽ 63.85; 63.85 ⩽ Sr ⩽ 112.45; 112.45 ⩽ Ba	**1**
1(b)(iii)	Identification of **M** as Group 2 metal with nearest A_r	**1**
1(c)(i)	Student not correct as too much gas for measuring cylinder OR Student not correct as the acid is not in excess.	**1**
1(c)(ii)	Student correct because CO_2 soluble in water / reacts with water.	**1**

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Question	Answer	Marks
2(a)	**I** Correct headings and units shown. Mass of crucible (+ lid) (Use of lid must be consistent) Mass of crucible (+ lid) + FA 3 Mass of crucible (+ lid) + residue / contents after heating Mass of FA 3 (used) Mass of residue	**1**
	II All balance readings to same dp **and** recorded mass **Q**CO_3 between 1.30 g and 1.50 g AND Mass **Q**CO_3 and residue correctly calculated	**1**
	Award **III** and **IV** if $\delta \leqslant 0.10$	**1**
	Award **IV** if $\delta \leqslant 0.20$ Do not allow any Q marks if mass of residue $\geqslant$ mass of FA 3.	**1**
2(b)(i)	Correctly calculates moles = candidate's mass lost / 44 **and** answer to 2 – 4 sf	**1**

Question	Answer	Marks
2(b)(ii)	Correct use of $M_r = \frac{\textit{candidate's mass of } \mathbf{Q}CO_3}{\textbf{(b)(i)}}$	**1**
	Use of 60	**1**
	Use of 3 – 4 sf for *M*r and correct A_r If no subtraction at step 2 then step 3 cannot be awarded. Identification of **Q** as Group 2 metal with nearest A_r Do not allow ecf if no evidence to support conclusion.	**1**
	Be ⩽ 16.65; 16.65 ⩽ Mg ⩽ 32.10; 32.10 ⩽ Ca ⩽ 63.85; 63.85 ⩽ Sr ⩽ 112.45; 112.45 ⩽ Ba	**1**
2(c)	So that water vapour / carbon dioxide (from air) not absorbed.	**1**
2(d)(i)	Heat to constant mass.	**1**
2(d)(ii)	Add an acid **and** it will fizz / bubble / effervesce **or** Add named acid **and** pass gas through limewater which turns milky / cloudy white / chalky / forms white ppt	**1**
2(e)(i)	(Mass lost too low →) **moles CO_2 too low** (→ moles **Q**CO_3 (or residue) too low → M_r too high →) **A_r too high**	**1**
2(e)(ii)	Method is valid since 1 mol **Q**CO_3 gives 1 mol **Q**O. **OR** moles QO : CO_2 = 1 : 1	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(i)</td><td>
<table>
<tr><td></td><td>FA 4</td><td>FA 5</td></tr>
<tr><td>HCl</td><td>No (visible) reaction / no change *
Allow pale yellow solution / colourless solution</td><td>Pale yellow / cream / white / off-white ppt *(ignore excess)</td></tr>
<tr><td>$CuSO_4$</td><td>Brown (ppt/ colour / soln) *
Do not allow orange/-brown or red-brown</td><td>Green soln *
allow blue-green / cyan / turquoise
ppt is CON</td></tr>
<tr><td>$AgNO_3$</td><td>(pale) Yellow ppt *</td><td>Yellow ppt / black ppt / grey ppt / (allow solid/ particles for ppt) *</td></tr>
<tr><td>+ NH_3</td><td>Insol in NH_3 *
Allow no change</td><td>ignore NH_3</td></tr>
<tr><td>Cl_2</td><td>Yellow or brown or red-brown / orange-brown / yellow-brown soln *
Do not allow orange.
Ppt is CON</td><td>No (visible) reaction / no change *
Allow colourless solution.</td></tr>
<tr><td>+ FA 5</td><td>Decolourised *
If Cl_2 reaction is incorrect then allow ecf
e.g. colourless solution</td><td></td></tr>
</table>
For every two correct observations (*) award 1 mark (round down)
Allow no observation for no (visible) change.</td><td>5</td></tr>
<tr><td>3(a)(ii)</td><td>FA 4 contains iodide / I^-
Or
FA 5 contains thiosulfate / $S_2O_3^{2-}$</td><td>1</td></tr>
<tr><td>3(a)(iii)</td><td>Reagent: starch
Observation expected: dark blue or blue / black colour</td><td>1</td></tr>
</table>

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Question	Answer	Marks
3(b)(i)	(Red) litmus turns blue Gas turns litmus blue is CON	**1**
3(b)(ii)	**Q**O(s) + $H_2O(l)$ → **Q**$(OH)_2$(s) / (aq)	**1**
3(c)(i)	hydrochloric / nitric acid allow sulfuric acid accept correct formula	**1**
3(c)(ii)	Clear layout to show tests, observations and conclusions.	**1**
	(Chooses) NH_3 Ignore NaOH / named sulfate / H_2SO_4 Any other reagent is CON	**1**
	FA 6: no ppt / no (visible) change / no reaction / colourless solution. (allow no observation)	**1**
	FA 7: white ppt insoluble in excess Ignore observations with other reagents	**1**
	M is calcium (or barium), **Q** is magnesium	**1**
3(c)(iii)	Conclusions to follow identification of **M** or **Q** in Questions **1** and **2** and conclusions of tests in **(b)(ii)**	**1**

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