Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills 1 **March 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.

Cambridge International is publishing the mark schemes for the March 2019 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.

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Question	Answer	Marks
1(a)	**I** Clear layout for 4 data items with unambiguous headings and units covering all entries (2 weighings, 1 mass, 1 gas volume)	**1**
	II Recording of volume of CO_2 (collected) **AND** both weighings **AND** mass of **FA 1** correctly calculated	**1**
1(b)(i)	All answers to parts **(ii)** to **(v)** are given to 2−4 sf	**1**
1(b)(ii)	Correctly calculates: $\frac{\text{V}\textbf{(a)}}{24.0 \times 1000}$ **AND** **(ii) = (i)**	**1**
1(b)(iii)	Correctly uses: **(iii) = (ii)** × 123.5	**1**
1(b)(iv)	Correctly uses: candidate's mass **FA 1** – **(iii)**	**1**
1(b)(v)	Correctly uses: moles $Cu(OH)_2$ = **(iv)** / 97.5	**1**
	Correctly uses: ratio **(ii)** : $n(Cu(OH)_2)$ = 1 : ..... *Allow correctly rounded to nearest integer.*	**1**
1(c)	Ticks 2nd box (**y** would increase): lower *T* => smaller volume (of CO_2) => smaller mass / moles / amount of $CuCO_3$ OR lower *T* => more CO_2 dissolves (=> less collected) => smaller mass / moles / amount $CuCO_3$ Ticks 3rd box (**y** unchanged): lower *T* => molar gas volume will be smaller (compensates for smaller volume)	**1**
1(d)	some CO_2 dissolves (in water) so: hot water in tub / saturate water with CO_2 initially / collect gas (directly) in gas syringe / use oil / non-polar solvent (in place of water)	**1**

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Question	Answer	Marks
2(a)	**I** Tabulates / clearly lays out all data	**1**
	II Appropriate headings and units for all items listed in the table • mass (empty) crucible (+ lid) • mass crucible (+ lid) + **FA 3** / contents before heating • mass crucible (+ lid) + contents after heating / residue • mass **FA 3** • mass of residue • mass loss Units: / g, (g), in grams. *Use of lid must be consistent.*	**1**
	III All recorded weighings to the same number of dp and all subtractions listed are correct (minimum 1)	**1**
	Examiner checks subtractions then calculates and records the difference between the supervisor's and candidate's mass ratio: mass **FA 3** ÷ mass loss (all to 2 dp)	
	IV Award **IV** if $\delta \leqslant \pm 0.80$	**1**
	V Award **V** if $\delta \leqslant \pm 0.60$	**1**
	VI Award **VI** if $\delta \leqslant \pm 0.40$ (*Supervisor > 10.00, tolerances are 1.20, 0.90, 0.60; Supervisor > 20.00, tolerances are 2.00, 1.50, 1.00*)	**1**
2(b)(i)	Correctly calculates: mass $CuCO_3$ from mass of **FA 3** in **(a)** $= \frac{60.0 \times \text{mass } \mathbf{FA}\,3}{100}$ **AND** Correctly uses moles $CuCO_3$ = answer/123.5	**1**
2(b)(ii)	Correctly calculates: $\frac{\text{mass residue}}{79.5}$ from mass of residue in **(a)**	**1**
2(b)(iii)	Correctly uses: **(iii) = (ii)** – **(i)**	**1**

Question	Answer	Marks
2(b)(iv)	Correctly uses: mass CO_2 = n($CuCO_3$) × 44	**1**
2(b)(v)	Correctly uses: mass H_2O = **(iii)** × 18	**1**
2(b)(vi)	mass loss in **(a)** – [**(iv)** + **(v)**] / comparison of values **AND** appropriate comment on presence / absence of water	**1**
2(c)(i)	prevents absorption of water (vapour) from atmosphere	**1**
2(c)(ii)	heat to constant mass / heat for longer to ensure all CO_2 and H_2O driven off OR increase the mass (of **FA 3**) (to reduce % error)	**1**
2(c)(iii)	add (named) acid **AND** fizz / effervescence / bubbling / gas gives white ppt with limewater (means student correct) OR no fizz indicates all $CuCO_3$ decomposed OR reheat residue **AND** pass any gas through limewater which turns milky (means student correct) OR limewater does not turn milky indicates all $CuCO_3$ decomposed	**1**

Question	Answer	Marks
	FA 4 is Cu_2O(s); **FA 5** is H_2SO_4(aq); **FA 6** is Cu powder	
3(a)(i)	**FA 4** + **FA 5** observations may be in either order blue solution formed / colourless to blue / solution turns blue / blue filtrate	**1**
	pink / brown / red-brown **AND** residue / solid	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)(ii)</td><td>
<table>
<tr><th>test</th><th>observations</th><th>marks</th></tr>
<tr><td>+ NH_3</td><td>((pale) blue ppt) forming deep / dark blue solution in excess</td><td>1</td></tr>
<tr><td>+ KI, then</td><td>turns brown / yellow-brown</td><td>1</td></tr>
<tr><td>+ $Na_2S_2O_3$</td><td>white ppt</td><td>1</td></tr>
<tr><td>+ HNO_3, then + $AgNO_3$</td><td>no (visible) reaction / no change / no ppt / remains a blue solution</td><td>1</td></tr>
<tr><td>+ HCl / HNO_3, then
+ BaCl_2 / $Ba(NO_3)_2$</td><td>white ppt</td><td>1</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>3(a)(iii)</td><td>FA 6 + nitric acid: (pale) blue solution</td><td>1</td></tr>
<tr><td></td><td>then + NaOH: (pale) blue ppt</td><td>1</td></tr>
<tr><td>3(b)(i)</td><td>metal ion: Cu^{2+} / copper(II) AND anion: SO_4^{2-} / sulfate</td><td>1</td></tr>
<tr><td>3(b)(ii)</td><td>$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
OR $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$
OR $2Cu^{2+}(aq) + 4I^-(aq) \rightarrow 2CuI(s) + I_2(aq)$ / (s)</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>redox (from some reaction in (a)(iii))
OR oxidation of metal / Cu
OR reduction of nitrate</td><td>1</td></tr>
<tr><td>3(c)</td><td>Na_2CO_3 (or other named carbonate) / Mg / Al / Zn / Fe / sodium thiosulfate</td><td>1</td></tr>
<tr><td></td><td>+ CO_3^{2-}: effervescence / gas turns limewater milky / chalky / cloudy white / white ppt
+ appropriate metal: effervescence / gas pops with lighted splint
+ thio: white / off-white / pale yellow ppt</td><td>1</td></tr>
<tr><td></td><td>Student is correct / FA 5 is an acid from correct observation</td><td>1</td></tr>
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