Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**CHEMISTRY** **9701/32**

Paper 3 Advanced Practical Skills 2 **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:<br><br>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:<br><br>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:** All the following data is recorded, with 'g' units<br><br>• three masses with unambiguous headings *(not 'weight')*<br>• both weighings recorded to same number of d.p. (one or more)<br>• mass of **FB 1** is correctly subtracted<br>• mass of **FB 1** used is between 2.5 and 2.7 g | **1** |
| | **II:** All the following data is recorded<br><br>• rough titration: both burette readings **and** the rough titre<br>• initial and final burette readings for **two** (or more) accurate titrations *(i.e. a 2 × 2 'box')*<br><br>*Headings and units are **not** required for this mark* | **1** |
| | **III:** **Correct headings** and units given in the **accurate** titration table<br><br>• initial / start **and** (burette) reading / volume<br>• final / end **and** (burette) reading / volume<br>• titre **or** volume / **FB 2 and** used / added *(not 'amount')*<br>• unit: / $cm^3$ **or** ($cm^3$) **or** in $cm^3$ (for each heading)<br>**or** $cm^3$ unit given for each volume recorded | **1** |
| | **IV:** All accurate burette readings are recorded to the nearest 0.05 $cm^3$. | **1** |
| | **V:** The **final** accurate titre recorded is within 0.10 $cm^3$ of any other accurate titre | **1** |
| | Award **VI**, **VII** and **VIII** if **$\delta \leq 0.10$** ($cm^3\ g^{-1}$) | **1** |
| | Award **VI** and **VII** if **$0.10 < \delta \leq 0.20$** | **1** |
| | Award **VI**, only if **$0.20 < \delta \leq 0.40$** | **1** |

| Question | Answer | Marks |
|---|---|---|
| 1(b) | **Candidate calculates the mean correctly.**<br><br>• Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 $cm^3$.<br>• Working / explanation must be shown.<br>• the mean should be quoted to **2 d.p.**, and be rounded to nearest 0.01 $cm^3$. | **1** |
| 1(c)(i) | **Significant figures**<br><br>The answers to **(ii)**, **(iii)** and **(iv)** must all be expressed to 3 or 4 sig. fig. | **1** |
| 1(c)(ii) | **Correctly calculates no of moles NaOH**<br><br>No. of moles of NaOH used = $0.110 \times$ mean titre / 1000 | **1** |
| 1(c)(iii) | Equation balanced with state symbols correct.<br><br>$NaOH(aq) + HSO_xNH_2(aq) \rightarrow NaSO_xNH_2(aq) + H_2O(l)$<br>**and**<br>correct answer: no. of moles of **FB 3** = ans **(ii)** | **1** |
| 1(c)(iv) | **Correct use of**<br><br>$M_r$ of **FB 1** = mass of **FB 1** weighed out / $10 \times$ no of moles of **FB 3** (from **(iii)**) | **1** |
| 1(c)(v) | **Correct expression and gives the answer as an integer**<br><br>**x =** [ans **(iv)** – 49.1] / 16 | **1** |

| Question | Answer | Marks |
|---|---|---|
| 1(d) | **Method:**<br><br>**Dissolve FB 1** in water **or** use **FB 3**<br>**and**<br>add (aqueous) $BaCl_2$ / $Ba(NO_3)_2$ **or** (aqueous) barium chloride / barium nitrate | **1** |
| | **Observation:** no reaction / no precipitate / solution stays colourless<br>**and**<br>**Deduction:** barium amidosulfonate is soluble in water | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a) | **I: Table / list of data**, to include values and correct headings and units:<br><br>• Mass of crucible (and lid)<br>• Mass of crucible, (lid) + **FB 4** (or 'contents before heating')<br>• Mass of crucible, (lid) + residue / CuO / contents after heating<br>• Mass of **FB 4** (used)<br>• Mass of residue / CuO (obtained) | **1** |
| | **Accuracy (Q) marks in 2(a)**<br><br>• To assess accuracy, check the masses of **FB 4** used and of CuO obtained by the supervisor and by the candidate.<br>• Work out the ratio $\frac{\text{mass of FB4}}{\text{mass of CuO}}$ for the supervisor (to 2 d.p.)<br>• Work out ratio (mass **FB 4**: mass CuO) for the candidate (2 d.p.)<br>• Calculate δ, the difference between these two ratios. | |
| | **Award II and III if $\delta \leqslant 0.05$** | **1** |
| | **Award III if $0.05 < \delta \leqslant 0.10$** | **1** |
| | **IV: Observations made during heating**<br><br>(Solid changes from) green / turquoise / cyan / blue-green to black *(both colours required)*<br>**or**<br>black solid / residue (formed) | **1** |
| 2(b)(i) | **Correctly calculated no. of moles of CuO**<br><br>• No. of moles CuO = $\frac{\text{mass of residue}}{79.5}$<br>• Answer must be correct and expressed to 2, 3 or 4 sig. fig. | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2(b)(ii) | **Correct use of mole ratio 1 : 2**<br><br>• No. of moles of **FB 4** = answer **(i)** / 2 | **1** |
| | **Correctly uses n to calculate $M_r$ of copper hydroxycarbonate,**<br><br>• $M_r$ = mass of **FB 4** used / no. of moles of **FB 4**<br>• Answer (for $M_r$) must be expressed to 2, 3 or 4 sig. fig.<br>• Some working must be shown to access the second mark | **1** |
| 2(b)(iii) | $M_r$ = 221 | **1** |
| | Appropriate **comment** on the value of **y**<br>• If answer **2(b)(ii)** is less than 221, candidate should state that **y** is negative, so the experiment has been inaccurate<br>• If answer **2(b)(ii)** is between 213 and 229, then (within experimental error) there is no water of crystallisation<br>• If answer **2(b)(ii)** is greater than 221, candidate should calculate the value of **y and** state that it should be an integer | **1** |
| 2(c) | Heat to constant mass (or description of procedure) | **1** |

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| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | **Observations when heating FB 5:**<br>• gas / ammonia turns (red) litmus blue | **1** |
| | **Any of the following score one mark each:**<br>• condensation produced **or** water droplets (at top of tube);<br>• white smoke / steam / steamy fumes produced;<br>• solid sublimes / solid forms at the top of the tube;<br>• **no** residue at the end of the expt. / solid changes to a gas / solid disappears | **2** |
| 3(a)(ii) | **Both observations required for first mark**<br>• fizzing / bubbling / effervescence<br>• solid dissolved **or** colourless solution formed<br>**or** (reaction is) rapid / vigorous | **1** |
| | **Gas tested:** gas / carbon dioxide turns lime water milky / cloudy white / white ppt / chalky | **1** |
| 3(a)(iii) | $(NH_4)_2CO_3$ | **1** |

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>Award one mark for every two correct observations (*)<br><br>
<table>
<tr><th>test</th><th>observations</th></tr>
<tr><td>+ U.I.</td><td>violet / blue / dark blue / purple *</td></tr>
<tr><td>+ $Mn^{2+}$</td><td>off-white / pale brown / buff / beige precipitate *<br>turns (darker) brown / dark on standing *</td></tr>
<tr><td>+ $H_2SO_4$</td><td>white precipitate *</td></tr>
<tr><td>+ $Ag^+$</td><td>brown / grey precipitate *</td></tr>
<tr><td>+ $NH_3$</td><td>(brown / grey ppt) soluble (in excess) / ppt disappears / forms colourless solution<br>or<br>white ppt forms (on standing) *</td></tr>
<tr><td>+ $Cu^{2+}$</td><td>(gives a) blue precipitate *</td></tr>
<tr><td>+ HC$l$</td><td>precipitate becomes paler<br>or<br>white / off-white precipitate / solid *</td></tr>
</table></td><td>4</td></tr>
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