
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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This document consists of **10** printed pages.

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.

| Question | Answer | Marks |
|----------|---|----------|
| 1(a) | <p>I: All the following data is recorded, with 'g' units</p> <ul style="list-style-type: none"> • three masses with unambiguous headings (<i>not 'weight'</i>) • both weighings recorded to same number of d.p. (one or more) • mass of FB 1 is correctly subtracted • mass of FB 1 used is between 2.5 and 2.7 g | 1 |
| | <p>II: All the following data is recorded</p> <ul style="list-style-type: none"> • rough titration: both burette readings and the rough titre • initial and final burette readings for two (or more) accurate titrations (<i>i.e. a 2 × 2 'box'</i>) <p><i>Headings and units are not required for this mark</i></p> | 1 |
| | <p>III: Correct headings and units given in the accurate titration table</p> <ul style="list-style-type: none"> • initial / start and (burette) reading / volume • final / end and (burette) reading / volume • titre or volume / FB 2 and used / added (<i>not 'amount'</i>) • unit: / cm³ or (cm³) or in cm³ (for each heading) or cm³ 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 |

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| Question | Answer | Marks |
|-----------|---|----------|
| 1(b) | <p>Candidate calculates the mean correctly.</p> <ul style="list-style-type: none"> • Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm³. • Working / explanation must be shown. • the mean should be quoted to 2 d.p., and be rounded to nearest 0.01 cm³. | 1 |
| 1(c)(i) | <p>Significant figures</p> <p>The answers to (ii), (iii) and (iv) must all be expressed to 3 or 4 sig. fig.</p> | 1 |
| 1(c)(ii) | <p>Correctly calculates no of moles NaOH</p> <p>No. of moles of NaOH used = $0.110 \times \text{mean titre} / 1000$</p> | 1 |
| 1(c)(iii) | <p>Equation balanced with state symbols correct.</p> <p>$\text{NaOH(aq)} + \text{HSO}_x\text{NH}_2\text{(aq)} \rightarrow \text{NaSO}_x\text{NH}_2\text{(aq)} + \text{H}_2\text{O(l)}$</p> <p>and</p> <p>correct answer: no. of moles of FB 3 = ans (ii)</p> | 1 |
| 1(c)(iv) | <p>Correct use of</p> <p>$M_r \text{ of FB 1} = \text{mass of FB 1 weighed out} / 10 \times \text{no of moles of FB 3 (from (iii))}$</p> | 1 |
| 1(c)(v) | <p>Correct expression and gives the answer as an integer</p> <p>$x = [\text{ans (iv)} - 49.1] / 16$</p> | 1 |

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| Question | Answer | Marks |
|-----------------|--|--------------|
| 1(d) | Method: Dissolve FB 1 in water or use FB 3 and add (aqueous) BaCl_2 / $\text{Ba}(\text{NO}_3)_2$ or (aqueous) barium chloride / barium nitrate | 1 |
| | Observation: no reaction / no precipitate / solution stays colourless and Deduction: barium amidosulfonate is soluble in water | 1 |

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| Question | Answer | Marks |
|----------|---|---|
| 2(a) | <p>I: Table / list of data, to include values and correct headings and units:</p> <ul style="list-style-type: none"> • Mass of crucible (and lid) • Mass of crucible, (lid) + FB 4 (or 'contents before heating') • Mass of crucible, (lid) + residue / CuO / contents after heating • Mass of FB 4 (used) • Mass of residue / CuO (obtained) <p>Accuracy (Q) marks in 2(a)</p> <ul style="list-style-type: none"> • To assess accuracy, check the masses of FB 4 used and of CuO obtained by the supervisor and by the candidate. • Work out the ratio $\frac{\text{mass of FB4}}{\text{mass of CuO}}$ for the supervisor (to 2 d.p.) • Work out ratio (mass FB 4: mass CuO) for the candidate (2 d.p.) • Calculate δ, the difference between these two ratios. <p>Award II and III if $\delta \leq 0.05$</p> <p>Award III if $0.05 < \delta \leq 0.10$</p> <p>IV: Observations made during heating</p> <p>(Solid changes from) green / turquoise / cyan / blue-green to black (<i>both colours required</i>) or black solid / residue (formed)</p> | <p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">1</p> <p style="text-align: center;">1</p> |
| 2(b)(i) | <p>Correctly calculated no. of moles of CuO</p> <ul style="list-style-type: none"> • No. of moles CuO = $\frac{\text{mass of residue}}{79.5}$ • Answer must be correct and expressed to 2, 3 or 4 sig. fig. | <p style="text-align: center;">1</p> |

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| Question | Answer | Marks |
|-----------|---|----------|
| 2(b)(ii) | <p>Correct use of mole ratio 1 : 2</p> <ul style="list-style-type: none"> No. of moles of FB 4 = $\frac{\text{answer (i)}}{2}$ | 1 |
| | <p>Correctly uses n to calculate M_r of copper hydroxycarbonate,</p> <ul style="list-style-type: none"> $M_r = \frac{\text{mass of FB 4 used}}{\text{no. of moles of FB 4}}$ Answer (for M_r) must be expressed to 2, 3 or 4 sig. fig. Some working must be shown to access the second mark | 1 |
| 2(b)(iii) | $M_r = 221$ | 1 |
| | <p>Appropriate comment on the value of y</p> <ul style="list-style-type: none"> If answer 2(b)(ii) is less than 221, candidate should state that y is negative, so the experiment has been inaccurate If answer 2(b)(ii) is between 213 and 229, then (within experimental error) there is no water of crystallisation 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: <ul style="list-style-type: none"> • <u>gas / ammonia</u> turns (red) litmus blue | 1 |
| | Any of the following score one mark each: <ul style="list-style-type: none"> • condensation produced or water droplets (at top of tube); • white smoke / steam / steamy fumes produced; • solid sublimes / solid forms at the top of the tube; • 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 <ul style="list-style-type: none"> • fizzing / bubbling / effervescence • solid dissolved or colourless solution formed or (reaction is) rapid / vigorous | 1 |
| | Gas tested: gas / carbon dioxide turns lime water milky / cloudy white / white ppt / chalky | 1 |
| 3(a)(iii) | $(\text{NH}_4)_2\text{CO}_3$ | 1 |

| Question | Answer | Marks | | | | | | | | | | | | | | | | |
|----------------------------------|---|-------------|---------------------|--------|--------------------------------------|--------------------|--|----------------------------------|---------------------|-------------------|----------------------------|-------------------|---|--------------------|------------------------------|-------|---|----------|
| 3(b)(i) | <p data-bbox="347 215 1052 247">Award one mark for every two correct observations (*)</p> <table border="1" data-bbox="347 279 1550 1013"> <thead> <tr> <th data-bbox="347 279 616 343"><i>test</i></th> <th data-bbox="616 279 1550 343"><i>observations</i></th> </tr> </thead> <tbody> <tr> <td data-bbox="347 343 616 406">+ U.I.</td> <td data-bbox="616 343 1550 406">violet / blue / dark blue / purple *</td> </tr> <tr> <td data-bbox="347 406 616 510">+ Mn²⁺</td> <td data-bbox="616 406 1550 510">off-white / pale brown / buff / beige precipitate * turns (darker) brown / dark on standing *</td> </tr> <tr> <td data-bbox="347 510 616 574">+ H₂SO₄</td> <td data-bbox="616 510 1550 574">white precipitate *</td> </tr> <tr> <td data-bbox="347 574 616 638">+ Ag⁺</td> <td data-bbox="616 574 1550 638">brown / grey precipitate *</td> </tr> <tr> <td data-bbox="347 638 616 805">+ NH₃</td> <td data-bbox="616 638 1550 805">(brown / grey ppt) soluble (in excess) / ppt disappears / forms colourless solution or white ppt forms (on standing) *</td> </tr> <tr> <td data-bbox="347 805 616 869">+ Cu²⁺</td> <td data-bbox="616 805 1550 869">(gives a) blue precipitate *</td> </tr> <tr> <td data-bbox="347 869 616 1013">+ HCl</td> <td data-bbox="616 869 1550 1013">precipitate becomes paler or white / off-white precipitate / solid *</td> </tr> </tbody> </table> | <i>test</i> | <i>observations</i> | + U.I. | violet / blue / dark blue / purple * | + Mn ²⁺ | off-white / pale brown / buff / beige precipitate * turns (darker) brown / dark on standing * | + H ₂ SO ₄ | white precipitate * | + Ag ⁺ | brown / grey precipitate * | + NH ₃ | (brown / grey ppt) soluble (in excess) / ppt disappears / forms colourless solution or white ppt forms (on standing) * | + Cu ²⁺ | (gives a) blue precipitate * | + HCl | precipitate becomes paler or white / off-white precipitate / solid * | 4 |
| <i>test</i> | <i>observations</i> | | | | | | | | | | | | | | | | | |
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