



A-LEVEL

Chemistry

CHM6X – Investigative and Practical Skills in A2 Chemistry

Mark scheme

Specification 2420

June 2015

Version: 1 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

Stage 1 Assessment : Task 1

| Marking Guidelines | Mark | Additional Guidance |
|--|-------------|---|
| Student reads the burette correctly | No mark | If the student does not read the burette correctly the centre should have told student the correct reading. |
| Results recorded clearly and in full in a sensible table | 1 | <p>If you can read it, it is clear.</p> <p>'Full' means the table must have 'initial reading', 'final reading' and titre values' for at least two sets of results.</p> <p>Labels such as 'initial reading', 'final reading' etc are not essential.</p> <p>The table does not have to have gridlines.</p> <p>Allow a clear answer outside a table box.</p> <p>Lose this mark if initial reading is recorded as 50 cm³</p> <p>Lose this mark if there is an arithmetic error in calculating a titre.</p> <p>Do not penalise missing units but lose this mark if units are incorrect.</p> <p>Do not penalise a student who does more than 5 titrations.</p> |
| All titre volumes to 0.05 cm ³ | 1 | <p>For example, accept 20.35, 20.30 but do not accept 20.3</p> <p>Allow zero entries as 0 or 0.0</p> <p>If a set of readings are labelled 'rough' ignore their precision, unless used to calculate the average.</p> |

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| <p>Concordant if two titres are within 0.10 cm^3 of each other</p> | <p>1</p> | <p>Award the mark for concordancy if the table contains at least two concordant results, even if the student has not recognised these as concordant titres.</p> <p>Do not award this mark if two concordant results are only achieved by incorrect arithmetic.</p> <p>Can score concordancy mark if titre volumes are only recorded to 1.decimal place but will lose Precision mark.</p> |
| <p>The accuracy of the student's average titre, measured against a teacher value for the titration</p> <p>This mark can be awarded independent of precision</p> <p>Average titre is within 1% of teacher value Average titre is within 1.5% of teacher value Average titre is within 2% of teacher value Average titre is within 2.5% of teacher value</p> <p>There is no penalty in the task for an incorrectly calculated average titre</p> <p>Enter your mark for burette (B), recording (R), precision (P), concordancy (C) and accuracy (A) in the table at the bottom of each Candidate Results Sheet</p> | <p>(A) 4 3 2 1</p> | <p>If a student has two concordant titres then both concordancy and accuracy marks can be awarded.</p> <p>If a student does not have two concordant titres but does have two titres within 0.20 cm^3 of each other, then the concordancy mark cannot be awarded but the accuracy marks can.</p> <p>Titres which differ from each other by more than 0.20 cm^3 cannot receive concordancy or accuracy marks.</p> <p>Check that the student has calculated the average titre correctly. If not, calculate the correct average and base the student's accuracy mark on the correct average. The student does not have to use all of the concordant titres in obtaining an average. (An incorrect average titre must be penalised in Q1).</p> <p>If a student has one set of concordant results, and has correctly identified these results, base the accuracy mark on the student's average titre</p> <p>A student may have one set of concordant titres, but uses a non-concordant titre in calculating the average. Average all the student's concordant titres, and use this average to determine the</p> |

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| | | <p>mark for accuracy.</p> <p>A student may have two sets of concordant titres which do not overlap. The teacher should choose the set of concordant titres that gives the higher accuracy mark, even if the student chooses the other set. Allow a correct calculation of an average titre for either set of concordant titres.</p> <p>Do not penalise a student who has done more than five titrations.</p> <p>If the initial burette reading is given as 50.00, and the final titre is given as, say 22.30, the titre could be 22.30 or 27.70. Use the value which gives the student the higher accuracy mark.</p> <p><i>If a teaching group scores low marks for accuracy, use the group average if this gives better results.</i></p> |
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Stage 2 Assessment: Task 2

| Marking Guidelines | Mark | Additional Guidance | | | | | | | | | | | | |
|--|---------------------|---|--------------------|---------|-------------------|---------|-------------------|---------|-------------------|---------|-------------------|--------|-------|---|
| Results recorded clearly and in full in two tables | (R) 1 | <p>If you can read it, it is clear.</p> <p>Full means completes all of the boxes.</p> <p>Allow a table without gridlines.</p> | | | | | | | | | | | | |
| <p>The accuracy of the observations.</p> <p>scoring points</p> <table data-bbox="136 826 593 1109"> <tr> <td>11–12 points scores</td> <td>6 marks</td> </tr> <tr> <td>9–10 points scores</td> <td>5 marks</td> </tr> <tr> <td>7–8 points scores</td> <td>4 marks</td> </tr> <tr> <td>5–6 points scores</td> <td>3 marks</td> </tr> <tr> <td>3–4 points scores</td> <td>2 marks</td> </tr> <tr> <td>1–2 points scores</td> <td>1 mark</td> </tr> </table> | 11–12 points scores | 6 marks | 9–10 points scores | 5 marks | 7–8 points scores | 4 marks | 5–6 points scores | 3 marks | 3–4 points scores | 2 marks | 1–2 points scores | 1 mark | (A) 6 | <p>Mark to the grid on page . If the teacher results differ from the published grid, consult your Assessment Adviser for guidance.</p> <p>If answers contradict, eg 'No visible change with effervescence' then scoring point is not awarded.</p> <p>Look for the basic colour; ignore additional shades if the answer is unambiguous.</p> <p>Accept 'no change', 'no reaction', 'stays the same', 'nvc' as well as 'no visible change'.</p> <p>Accept 'bubbles of gas', 'fizzes', 'colourless gas formed' or 'CO₂ evolved' as well as 'effervescence'. Do not allow 'CO₂ formed/produced'</p> <p>Do not accept 'clear' instead of colourless.</p> <p>Do not accept 'cloudy', 'misty', 'milky' or 'emulsion' <i>instead of white (precipitate)</i>.</p> <p><i>Ignore cloudy when precipitate is also stated.</i></p> <p><i>Penalise missing 'solution' once only</i></p> <p><i>Penalise missing 'precipitate' (or equivalent) each time.</i></p> |
| 11–12 points scores | 6 marks | | | | | | | | | | | | | |
| 9–10 points scores | 5 marks | | | | | | | | | | | | | |
| 7–8 points scores | 4 marks | | | | | | | | | | | | | |
| 5–6 points scores | 3 marks | | | | | | | | | | | | | |
| 3–4 points scores | 2 marks | | | | | | | | | | | | | |
| 1–2 points scores | 1 mark | | | | | | | | | | | | | |

Tests with solution P

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| Test 1 Test with water | Green solution* to Blue solution (1) |
| Test 2 Barium chloride solution | Green solution to white precipitate (1) |
| Test 3 Silver nitrate solution | Green solution to white precipitate (1) |

**Penalise missing green solution only once*

Tests with solution Q, R and S

| | Solution Q | Solution R | Solution S |
|---|---------------------------------|-------------------------------|--|
| Test 4 Reagent X | Red / orange (not brown) ** (1) | (Dark) purple / Violet ** (1) | Yellow ** (1) |
| Test 5 Fehling's solution | (Brick-)red precipitate (1) | (Brick-)red precipitate (1) | No visible change or blue solution (1) (As hydrolysis of sucrose may occur over time, allow (brick-)red / grey-green precipitate) |
| Test 6 Saturated sodium hydrogen carbonate solution | No visible change (1) | No visible change (1) | Effervescence (1) |

** It can be difficult to judge whether it is the solution or the solid that is causing the colour so mark for colour only.

Stage 2 Assessment (Written Test): Section A

- Ignore absence of units unless units are required in the Marking Guidelines.
- Incorrect units lose the mark.
- Incorrect rounding of calculations must be penalised, but only once per paper.

| Question | Marking Guidelines | Mark | Additional Guidance |
|----------|---|--------|--|
| 1 | Calculates the correct average titre using concordant results only | 1 | Allow any set of concordant results for the average. Do not penalise precision here. Do not award to students who have been given the teacher's value. Allow without working so long as it is clear which results have been used – look at the Candidate Results Sheet as well. |
| 2 | Q1 × 0.05 / 1000 M1 Their M1 × 40 M2 | 1 1 | M1, M2 shown to allow stepped marks. <i>Allow alternative methods to the correct answer.</i> |
| 3 | (10 g of flower food enough for) 5 dm ³ M1 Add 4.75 dm ³ (or M1 – 250cm ³) | 1 1 | <i>Allow answers in cm³</i> <i>Correct units must be given and must match the answer</i> <i>Correct answer with units scores both marks</i> |
| 4(a) | As a droplet from the funnel could enter the burette / affect volume / readings / titre | 1 | |

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| 4(b) | Air bubble in jet or wtte | 1 | <i>Do not allow misreading burette or overshooting end point.</i> |
| 4(c) | <i>Ensures all reagents are able to react / mix / come into contact</i> | 1 | Accept no reagent is left unreacted on sides of flask <i>Do not allow any reference to 'removal' of the solution unless it is clear that it is added to the flask.</i> |
| 4(d) | <i>The added water does not affect the mols / amount of reagents / reactants / solution Z</i> | 1 | <i>Do not allow mols of solution or mols in the flask.</i> <i>Allow water does not react with the reagents / water is not one of the reactants</i> <i>Do not allow 'water is not involved'</i> |
| 5(a) | Pipette = $0.05 \times 100 / 25.0 = 0.2\%$ Burette = $0.15 \times 100 / Q1$ | 1 1 | <i>Ignore precision</i> <i>Must show working</i> <i>Allow one mark for two correct answers with no working</i> |
| 6(a) | Chloride / Cl^- | 1 | Mark consequentially to candidate's results if precipitate is cream or yellow. Blue precipitate in Task 2, test 3 CE = 0 |
| 6(b) | Sulfate / SO_4^{2-} only | 1 | Accept carbonate unless given as an answer in Q6(a) Blue precipitate in Task 2, test 3 CE = 0 |
| 6(c) | CuCl_4^{2-} $\text{Cu}(\text{H}_2\text{O})_6^{2+}$ | M1 M2 | Allow either order |

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| 7(a) | Q and R | 1 | Consequential on student's results Must state all solutions that gave a positive result |
| | Test 5 produced a brick-red precipitate | 1 | Allow Test 5 gave a positive result for aldehyde |
| 7(b) | S | 1 | Consequential on student's results |
| | Test 6 gave a (colourless) gas / effervescence / CO ₂ | 1 | <i>Allow none of the solutions because there was no effervescence, if this matches the results, for both marks.</i> Wrong solution CE = 0 |

Stage 2 Assessment (Written Test): Section B

- Ignore absence of units unless units are required in the Marking Guidelines.
- Incorrect units lose the mark.
- Incorrect rounding of calculations must be penalised, but only once per paper.

| Question | Marking Guidelines | Mark | Additional Guidance |
|----------|--|------|---|
| 8(a) | (Biocide) reacts with bacteria / used up killing bacteria Chlorine given off / evaporates Chlorine has reacted with water to form (HCl and) O ₂ | 2 | Max two marks Do not allow "chlorine has reacted with water" alone. Do not allow products of HCl and HOCl alone |
| 8(b) | the concentration of the remaining solution (after a sample has been removed) is unchanged. | 1 | |
| 8(c) | So that all chlorine was reacted / reduced | 1 | Do not allow 'all of the iodide was oxidised' |
| 8(d) | The E° value for the iodine half-equation is more positive than that for the thiosulfate | 1 | Allow = 0.45 Must refer to values |
| 8(e) | $\text{S}_2\text{O}_3^{2-} + \frac{1}{2}\text{I}_2 \rightarrow \text{I}^- + \frac{1}{2}\text{S}_4\text{O}_6^{2-}$ | 1 | Allow multiples |
| 9(a) | <u>164.0</u> | 1 | Must be 1 decimal place |

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| 9(b) | 17.1(%) (= $28.0 \times 100 / Q9a$) | 1 | <i>Consequential on their 9(a) Ignore precision but must be to at least 2 sig fig. (i.e. accept 17 or 17.07)</i> |
| 9(c)(i) | <i>Absorption</i> depends on (proportional to) path length / distance travelled through solution | 1 | <i>Do not allow size.</i> |
| 9(c)(ii) | To select the colour/frequency/wavelength that is (most strongly) absorbed (by the sample) | 1 | <i>Allow the filter is chosen to complement the colour of the solution</i> |
| 9(c)(iii) | Quicker to analyse extracted samples than by titration / uses smaller volumes of solution | 1 | |

Stage 2 Assessment (Written Test): Section C

- Ignore absence of units unless units are required in the Marking Guidelines.
- Incorrect units lose the mark.
- Incorrect rounding of calculations must be penalised, but only once per paper.

| Question | Marking Guidelines | Mark | Additional Guidance |
|----------|--|------|--|
| 10(a) | <i>Multiply volume of propan-1-ol by density</i> | 1 | <i>Allow measure the mass of the volume added</i> <i>Any reference to concentration of propan-1-ol CE=0</i> |
| | <i>Divide the mass by the M_r of propan-1-ol</i> | 1 | |
| 10(b) | Titrate a measured volume of the concentrated HCl added initially to determine moles of HCl used in the experiment | 1 | Allow addition of AgNO ₃ to form AgCl precipitate. Use mass of precipitate to calculate initial moles of HCl added. |
| | Subtract this number of moles of HCl from the total moles of acid at equilibrium | 1 | |
| 10(c) | M1 ester will evaporate / escape | 1 | Allow reactants / products will evaporate |
| | M2 incorrect values used (to determine K_c) | 1 | Allow the system will no longer be at equilibrium Do not allow references to equilibrium position shifting alone |