

**General Certificate of Education (A-level)
June 2013**

Chemistry

CHM3X

(Specification 2420)

Unit 3X: Practical and Investigative Skills

Externally-Assessed Practical Assignment

Final

Mark Scheme

Mark Schemes are prepared by the Principal Moderator and considered, together with the relevant questions, by a panel of subject teachers.

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Task 1 Assessment

| Marking Guidelines | Mark | Additional Guidance |
|--|-------------|---|
| Results recorded clearly and in full in a sensible table | (R) 1 | <p>If you can read it, it is clear.</p> <p>'Full' means the table must have the following five masses recorded:</p> <ol style="list-style-type: none">1 Crucible2 Crucible + NaHCO₃3 Crucible + sample after step 54 Crucible + sample after step 65 Crucible + sample after step 7 <p>Each mass must be clearly labelled.</p> <p>The table does not have to have gridlines.</p> <p>Do not penalise missing units but lose this mark if units are incorrect.</p> <p>Ignore additional information such as calculated masses.</p> |
| All masses must be recorded to <u>2 decimal places</u> | (P) 1 | |
| Completion - it must be clear that the student has fully decomposed the sample | (C) 1 | Allow a small variation between the fourth and fifth mass to allow for balance variation (± 0.03 g). |

| | | | | | | | | | | |
|---|-----------------|-------|---------|---|---------|---|---------|---|--|--|
| <p>Accuracy of the student's answer to Question 1(b) in Written Test</p> <p>This mark can be awarded independent of precision</p> <p>Percentage of solid remaining after heating is</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">63.1±2%</td> <td style="text-align: center;">(A) 4</td> </tr> <tr> <td style="text-align: right;">63.1±3%</td> <td style="text-align: center;">3</td> </tr> <tr> <td style="text-align: right;">63.1±4%</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: right;">63.1±5%</td> <td style="text-align: center;">1</td> </tr> </table> | 63.1±2% | (A) 4 | 63.1±3% | 3 | 63.1±4% | 2 | 63.1±5% | 1 | | <p>It will be necessary to check that the student has completed the calculation correctly.</p> <p>Also check the teacher's result. If this varies from 63.1% allow the student the best accuracy mark based on 63.1% or the teacher value.</p> <p>There is no penalty in this Task for an incorrectly calculated percentage.</p> |
| 63.1±2% | (A) 4 | | | | | | | | | |
| 63.1±3% | 3 | | | | | | | | | |
| 63.1±4% | 2 | | | | | | | | | |
| 63.1±5% | 1 | | | | | | | | | |
| <p>Total</p> | <p>7</p> | | | | | | | | | |

Task 2 Assessment

| Marking Guidelines | Mark | Additional Guidance |
|--|------------|--|
| Student reads the thermometer correctly to 1 decimal place | Not marked | If the student reads incorrectly, tell the student the correct reading. |
| 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 the temperature row/column correctly, with no entry for the fourth minute if a space for this time has been left in the table.</p> <p>There must be two masses recorded for the weighings. Ignore a calculation of the mass used, even if incorrect.</p> <p>An entry for zero minutes must be present. Allow \n initial temperature of the acid clearly stated.</p> <p>Allow a table without gridlines.</p> <p>Allow a clear answer outside any box.</p> <p>Do not penalise missing units but lose this mark if units are incorrect.</p> |
| All temperatures readings to 1 decimal place and masses to 2 decimal places | (P) 1 | |

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|--|-----------------|--|
| <p>The accuracy of the student's enthalpy of neutralisation as calculated in the Written Test, measured against a teacher value</p> <p>within 3% of teacher value - 5 marks within 5% of teacher value - 4 marks within 8% of teacher value - 3 marks within 10% of teacher value - 2 marks within 12% of teacher value - 1 mark</p> | <p>(A) 5</p> | <p>It is essential that the student's graph is checked carefully for plotting and extrapolation.</p> <p>The teacher value must also be checked carefully and written on the Candidate Results Sheet for Task 2.</p> <p>The teacher value for ΔH is given by $10.5 \times (\text{T change} / \text{mass})$.</p> <p>Check that the answers to Section A Questions 7, 8 and 9 are correct before allocating marks for accuracy – if an answer is incorrect underline this and write the correct value beside it.</p> <p>If the student's answer to Section A Question 7 is wrong, underline the wrong value and write the correct value for the temperature rise alongside – use this corrected answer to Question 7 to assess accuracy.</p> |
| <p>Total</p> | <p>7</p> | |

| | | | |
|---|--|-----------------------|---|
| 3 | $= [(Q2 - Q1(b)) / Q2] \times 100$ | 1 | Allow zero as the answer. Allow $Q1(b) - Q2$ Ignore negative sign in answer. Do not penalise precision. |
| 4 | $= (0.01 / \text{Mass 1 from Q1(a)}) \times 100$ | 1 | Allow this answer only. Answer should be approx. 0.5% Do not penalise precision. |
| 5 | Crucible was not heated long enough / heating was insufficient / incomplete decomposition | 1 | If student's answer to Q2 is higher than 87.3 allow any suggestions of further decomposition. If a student has used a lid allow water condenses in / may remain in the crucible. Do not allow answers based on lack of purity. References to combustion of the sample lose this mark. |
| 6 | Temperature on the y -axis Scale Points plotted correctly Best-fit lines are feasible Extrapolations are correct | 1 1 1 1 1 | Do not penalise lack of labelling of axes/units (unless incorrect). Plotted points must cover at least half the printed grid. Allow \pm one small square. Both lines must be feasible. Both lines must be correctly extended to the fourth minute. Penalise kinked, doubled or very thick lines by 1 mark. |

| | | | |
|--------------|---|-------------|---|
| 7 | Correct T fall at the fourth minute from student's graph Answer given to 1 decimal place | 1 | Allow consequential answer based on student's lines. Allow \pm one small square. Ignore negative sign in answer. Both points are needed to gain this mark. |
| 8 | Use of $q=mc\Delta T$ = <u>30</u> \times 4.18 \times Q7 = correct answer (in J or kJ) | 1 1 1 | Can be implied from next step. Lose this mark if mass is not 30 or ΔT is incorrect. Do not penalise precision but do not allow 1 significant figure. Do not need to state units but if given the units must be correct for the final answer. |
| 9 | Moles $\text{NaHCO}_3 = \text{Mass of NaHCO}_3 \text{ from Task 2} / 84$ Enthalpy = Q8 / (1000 \times mol NaHCO_3) Correct answer | 1 1 1 | Do not penalise precision but do not allow 1 significant figure. Allow consequential M_r from Q2 Allow this mark if the + sign is missing but lose this mark for a negative final answer. If final answer is the only written text then penalise lack of working by 1 mark if correct. Allow answer in J or kJ but units must be correct for the final answer. Given data 1250 / (1000 \times mol NaHCO_3) |
| Total | | 19 | |

CHM3X 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 |
|----------|--|---------------------|---|
| 10 | HOOC—CHOH—CHOH—COOH | 1 | Any suitable structural formula. Displayed formula not required but bond sequences must be correct if shown. |
| 11 | $C_4H_6O_6 + NaHCO_3 \rightarrow C_4H_5O_6Na + CO_2 + H_2O$ OR $C_4H_6O_6 + 2NaHCO_3 \rightarrow C_4H_4O_6Na_2 + 2CO_2 + 2H_2O$ | 1 | Allow equations based on the structural formula. Allow multiples including fractions. Allow any structure for $C_4H_6O_6$ or $C_4H_5O_6Na$ |
| 12 | Suitable named indicator (eg litmus, methyl orange, Universal Indicator) / identified reactive metal (Mg, Zn or Fe) Appropriate colour in acid (eg red) / gas evolved | 1 1 | Do not allow phenolphthalein without explanation of how a colour change would be seen. Incorrect reagent, chemical error = 0/2 |
| 13(a) | Reagent: <u>Acidified potassium dichromate</u> (solution) Obs: orange to green Obs: no (visible) change | 1 1 1 | If incomplete (correct) reagent, lose M1 but mark on. Incorrect reagent, chemical error = 0/3 Allow acidified potassium manganate(VII) Purple to colourless (solution). Allow 'no visible reaction, but do not allow 'no reaction' without qualification. |

| | | | |
|--------------|---|-----------|--|
| 13(b) | Both would give the same result / both oxidised by reagent / both react with the reagent or similar | 1 | Allow consequential answer from Q13(a). Chemical error if reagent in Q13(a) is incorrect, 0/1 |
| 14 | The water would allow the tartaric acid and sodium hydrogencarbonate to react (before use) | 1 | Ignore any reference to water reacting with the ingredients. Ignore references to prevention of 'caking' or 'clumping'. Ignore references to shelf life without qualification. |
| 15 | Acid reacts (with NaHCO_3 / Na_2CO_3) to form CO_2 | 1 | Allow 'neutralises (NaHCO_3 / Na_2CO_3) to form CO_2 '. |
| 16 | It is only used in very small quantities | 1 | Allow 'decomposes in the reaction'. Do not allow 'reacts' without qualification. Ignore reference to formation of salts. |
| Total | | 11 | |

CHM3X 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 |
|--------------|--|----------|--|
| 17(a) | Any three from: A method of weighing by difference / wash the solid from its weighing container into the beaker Wash the (wet) rod into the flask / beaker after use Wash the (wet) beaker into the flask after transfer Wash the filter funnel (after transfer) into the flask Use a teat pipette to make up to the mark on the volumetric flask Ensure the <u>bottom of the (liquid) meniscus</u> is on the graduation mark Mix / shake the final solution in the flask / invert flask | Max 3 | If the nature of any washing is imprecise penalise once only. Do not allow a method where the solution is made up directly in the flask. Ignore any instructions that refer to rinsing equipment (before use) or use of deionised water. |
| 17(b) | Do (a) further titration(s) To obtain concordant results | 1 1 | Mark these points independently. Allow results with ± 0.1 |
| 18 | Mg ²⁺ and Cl ⁻ | 1 | Do not allow names. |
| Total | | 6 | |