

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

Chemistry

CHM6X

(Specification 2420)

Unit 6X: Practical and Investigative Skills

Externally-Assessed Practical Assignment

Final

Mark Scheme

Marking Guidelines 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
Student reads the burette correctly	No mark	If the student does not read the burette correctly, tell the student the correct reading.
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 '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 cm^3.</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	(P)1	<p>For example, accept 20.35, 20.30 but do not accept 20.3. (Do not accept values of 20.31, 20.37 etc)</p> <p>Allow zero entries as 0 or 0.0</p> <p>If one set of readings are labelled 'rough' or 'trial', ignore their precision, unless used to calculate the average.</p>

<p>Concordant if two titres are within 0.20 cm³ of each other (as a result of possible errors from the weighings, the concordancy limit is extended in this experiment)</p>	<p>(C)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>Calculate the value of $(50 - \text{titre value}) / \text{mass of Bordeaux mixture}$.</p> <p>Value is within 2.5% of teacher value Value is within 3% of teacher value Value is within 3.5% of teacher value Value is within 4% of teacher value</p> <p>There is no penalty in the task for an incorrectly calculated average titre.</p> <p>Enter your mark for 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 0.40 cm³ 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 0.40 cm³ cannot receive concordancy or accuracy marks.</p> <p>Check calculation of the average titre is correct. If not, calculate the correct average and base the accuracy mark on this correct average. The student need not use all the concordant titres for 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 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>
Total	7	

Task 2 Assessment

Marking Guidelines	Mark	Additional Guidance
Results recorded clearly and in full in a table	(R) 1	If you can read it, it is clear. Full means completes all of the boxes. Allow a table without gridlines.
The accuracy of the observations scoring points 10 points scores 6 marks 8-9 points scores 5 marks 6-7 points scores 4 marks 4-5 points scores 3 marks 2-3 points scores 2 marks 1 point scores 1 mark	(A) 6	Mark to the grid on page 7. If answers contradict, eg 'No visible change with effervescence' then scoring point is not awarded. Look for the basic colour; ignore additional shades if the answer is unambiguous. Accept 'no change', 'no visible reaction', 'stays the same', 'nvc' as well as 'no visible change'. Do not accept 'clear' instead of colourless. Ignore 'cloudy', 'misty', 'milky' or 'emulsion'. Penalise 'cloudy' or 'milky' with 'solution' ie a contradiction. Accept 'ppt', 'suspension', 'sediment' and 'solid' instead of precipitate. Penalise missing 'precipitate' every time. Penalise missing 'solution' but only once. Penalise 'no reaction' but only once.
Total	7	

Test 1 Bordeaux mixture + H ₂ O	(Pale) blue ppt./ blue solid (does not dissolve) (1) Ignore 'white solid/ppt.'. Ignore 'blue solution'.
Test 2 Bordeaux mixture + HNO ₃	<u>Blue solution</u> (1) (If there is a comment about a small amount of white solid remaining; ignore)
Test 3 Bordeaux mixture + H ₂ SO ₄	Filtrate: <u>Blue solution</u> (1) Solid in filter paper: <u>White</u> (1)
Test 4 Filtrate + NH ₃	(Pale) <u>blue ppt.</u> (1) <u>Deep/dark blue solution</u> (1)
Test 5 Filtrate + KI	(Red-) <u>Brown</u> or <u>orange</u> solution (1) Do not accept 'red solution'. Allow 'straw'. Cream/white/off-white/ <u>pale brown ppt.</u> (1)
Test 6 Filtrate + Fehling's B + Glucose	Green/yellow <u>ppt.</u> initially (1) Ignore any reference to the initial (deep) blue solution Red/orange <u>ppt.</u> at end (1) Ignore 'purple solution' or 'purple ppt.'

CHM6X 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 (at least two results)	1	<p>Answer must be to 2 decimal places. The second place can be the nearest 0 or 5 or a correct mathematical average of the concordant titres ($\pm 0.2 \text{ cm}^3$).</p> <p>Do not award to students given teacher's results.</p> <p>Allow a correct calculation of an average titre for either set of two sets of concordant results, even from incorrect arithmetic in the Task table.</p> <p>Award this mark for a correct answer on the Written Test even if it is different from the average titre on the Candidate Results Sheet.</p> <p>Lose this mark if the student has no concordant titres.</p>
2	$= (25.0 \times 2.00) / 1000 = 0.05(00)$	1	Do not penalise precision.
3(a)	$= (Q1 \times 0.100) / 1000$	1	Do not penalise precision but do not allow 1 significant figure.

3(b)	Moles of HCl used in each titration = Q3(a)	1	Allow alternative methods so long as correct working shown. M2 also scores M1 Final correct answer without working scores 1 mark. Do not penalise precision but do not allow 1 significant figure.
	Moles of HCl remaining in beaker = Q3(a) × 10	1	
	Moles of HCl used up by Bordeaux mixture = Q2 – (Q3(a) × 10)	1	
4(a)	$\text{Ca(OH)}_2 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$	1	Allow multiples, including fractions. Ignore state symbols. Allow $\text{Ca(OH)}_2 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + 2\text{H}_2\text{O}$ but not $\text{OH}^- + \text{H}^+ \rightarrow \text{H}_2\text{O}$
4(b)	Mol of $\text{Ca(OH)}_2 = \text{Q3(b)} / 2$	1	Allow use of given data; 0.0212 → 0.0106 → 0.785 g for 3 marks. Allow × 74 Lose 1 mark if no working shown. If incorrect reacting ratio used, can score M2 if a number of moles is multiplied by 74.1 Award this mark if answer is to 3 significant figures even if the mass is incorrect (unless the wrong ratio used). If answer not to 3 significant figures do not award this mark.
	Mass of $\text{Ca(OH)}_2 = (\text{Q3(b)} / 2) \times 74.1$	1	
	Answer to 3 significant figures	1	
4(c)	$= (\text{Q4b} / \text{mass of Bordeaux mixture from Task 1 of Candidate Results Sheet}) \times 100$	1	Do not penalise precision but do not allow 1 significant figure. Allow if correct method gives answer over 100% (eg as a result of mistake in Q3b.)

5	$\text{Ca(OH)}_2 + \text{CuSO}_4 \rightarrow \text{Cu(OH)}_2 + \text{CaSO}_4$	1	Do not allow separate ionic formulae on the right. Allow correct equation that includes water ligands.
6	$[\text{Cu(H}_2\text{O)}_6]^{2+}$	1	Square brackets not essential. Allow this answer only. Ignore (aq).
7	CaSO_4	1	Accept $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
8	(The solution is) coloured / blue	1	Lose mark if any reference to an oxidation state change in Test 3
9	The ammonia reacted (initially) with (excess sulfuric) acid	1	Allow 'ammonia neutralised'.
10	Iodine / I_3^- / I_2 / KI_3 (no charge)	1	Do not allow I or I^-
11	Aldehyde / CHO	1	If there was no visible change for Test 6 then allow 'aldehyde not present'.
12	The Bordeaux mixture / copper(II) hydroxide sticks to the plant Copper(II) sulfate dissolves	1 1	Allow ' CuSO_4 solution is easily washed off the plant'. Must refer to the plant at least once in the answer to score both marks.
13	<u>Build up</u> of toxic (copper(II) ion) / chemicals in the soil / water	1	Allow 'development of resistance to Bordeaux mixture'
Total		21	

CHM6X 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
14(a)	Two rings only around nitrogen or sulfur	1	Lose this mark if more than 2 atoms are ringed. Do not allow two atoms at the same end of the ion.
14(b)	275.8	1	Accept this answer only. Do not allow 276
14(c)	Carboxylate / COO ⁻	1	Allow salt of carboxylic acid or just carboxylic acid.
15	$(32.1 / 102.1) = 31.4\%$	1	Do not penalise precision but do not allow 1 significant figure.
16	Zineb is mixed with a <u>solvent / water</u>	1	Max=2 if M1 missed
	Use of column / paper / TLC	1	Lose M1 and M2 for GLC
	Appropriate collection of the ETU fraction OR Appropriate method of detecting ETU	1	Allow ETU is an early fraction in a column or collecting a range of samples over time, lowest retention time / travels furthest on paper or TLC (allow 1 mark for having the longest retention time in GLC).
	Method of identification of ETU (by <u>comparison</u> with standard using chromatography)	1	If method completely inappropriate, only M1 is accessible
Total		8	

CHM6X 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)	To remove the <u>oxide</u> layer on the aluminium	1	Do not allow 'cleaning' or 'removal of grease'. Do not allow 'removal of impurities' without qualification.
17(b)	An appropriate method for delivering H ₂ gas over a Pt electrode	1	Need H ₂ gas and Pt electrode labelled (allow gas delivered directly below the electrode). Ignore any concentration or pressure values. Ignore absence of bubbles. Allow if electrode is below outer acid level.
	The Pt electrode must clearly in contact with a solution of a named acid.	1	
17(c)	The carbonate ion reacts with the acid (in the SHE) / reaction between carbonate and Al ³⁺	1	Lose this mark if aluminium carbonate formed but mark on.
	Reaction given (either equation or products specified)	1	
	OR H ⁺ / Al ³⁺ concentrations change/cell e.m.f. altered		
18	Measure pH <u>with a meter</u>	1	Chemical indicators not allowed for M1 (allow mark for M2 if student describes differences in pHs but not for differences in colours). Use of CuSO ₄ not allowed.
	Methylamine would have a <u>higher pH</u> / ammonia would have a <u>lower pH</u>	1	
Total		7	