

Version 1.1



**General Certificate of Education (A-level)
June 2011**

Chemistry

CHM6X

(Specification 2420)

**Unit 6X: Investigative and practical skills in A2
Chemistry**

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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CHM6X Task 1 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.

Check the teacher observations against the answers below.

Allow **either** the published answer **or** the teacher alternative, as long as this is reasonable.

If answers contradict eg "No visible change with green precipitate" then scoring point is **not** awarded.

<p>The accuracy of the observations. 12 scoring points</p> <table> <tr> <td>11 -12</td> <td>points scores</td> <td>6 marks</td> </tr> <tr> <td>9 -10</td> <td>points scores</td> <td>5 marks</td> </tr> <tr> <td>7 -8</td> <td>points scores</td> <td>4 marks</td> </tr> <tr> <td>5 - 6</td> <td>points scores</td> <td>3 marks</td> </tr> <tr> <td>3 - 4</td> <td>points scores</td> <td>2 marks</td> </tr> <tr> <td>1 - 2</td> <td>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>The candidate's observations for iron(II) sulfate are not marked.</p> <p>Accept suspension, sediment, solid deposit as well as precipitate.</p> <p>Do not accept cloudy, misty or emulsion.</p> <p>Accept (colourless) gas produced, fizzes as well as effervescence.</p> <p>Look for the basic colour; ignore additional shades if the answer is unambiguous.</p> <p>If centre puts 'orange/yellow' allow 'orange' or 'yellow'.</p> <p>If 'precipitate' missing in the answer, penalise each omission.</p> <p>If 'solution' missing in the answer, penalise once.</p> <p>Penalise 'green solution and precipitate' once only, but colour of precipitate must be unambiguous.</p> <p>For the chromium precipitates allow blue-green or grey-green.</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																		
Total	7																			

	Observations with Chromium(III) sulfate solution	Observations with Iron(III) sulfate solution
<p>Test 1 Ammonia solution</p> <p>Place about 10 drops of the sample in a test tube. Add ammonia solution, dropwise with shaking, until in excess.</p>	<p>green precipitate (1)</p> <p>purple solution in excess (1)</p> <p>Allow insoluble in excess or partially soluble in excess</p>	<p>orange/ red/ brown precipitate (1)</p> <p>insoluble in excess (1)</p>
<p>Test 2 Sodium carbonate solution</p> <p>Place about 10 drops of the sample in a test tube. Add 10 drops of sodium carbonate solution, and shake the mixture.</p>	<p>green precipitate (1)</p> <p>effervescence (1)</p>	<p>orange/ red/ brown precipitate (1)</p> <p>effervescence (1)</p>
<p>Test 3 Potassium thiocyanate solution</p> <p>Place about 10 drops of the sample in a test tube. Add 10 drops of potassium thiocyanate solution, and shake the mixture.</p>	<p>green solution/ no visible change (1)</p>	<p>dark red solution (1)</p>
<p>Test 4 Potassium hexacyanoferrate(II) solution</p> <p>Place about 10 drops of the sample in a test tube. Add 10 drops of potassium hexacyanoferrate(II) solution, and shake the mixture.</p>	<p>green precipitate (1)</p>	<p>(dark) blue precipitate (1)</p>

CHM6X Task 2 Assessment

Marking Guidelines	Mark	Additional Guidance
Results recorded clearly and in full in a sensible <u>table</u>	(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>Table does not have to have gridlines.</p> <p>Allow clear answer outside of a table box.</p> <p>Lose this mark if there is an arithmetic error in calculating a titre.</p> <p>Units are not needed in a results table, but if given they must be correct.</p> <p>Labels such as <i>Initial reading</i>, <i>Final reading</i> etc are not needed in this very familiar table.</p> <p>If the initial burette reading is given as 50.00 then R = 0</p>
All titre volumes to 0.05 cm ³	(P) 1	<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>
Concordant if two titres are within 0.10 cm ³ of each other	(C) 1	<p>Award the mark for concordancy if the table contains at least two concordant titres, even if candidate 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 d.p. but will lose Precision mark.</p>

<p>The accuracy of the candidate's average titre, measured against a teacher value for the titration.</p> <p>average titre is within 1% of teacher value 4 marks</p> <p>average titre is within 1.5% of teacher value 3 marks</p> <p>average titre is within 2% of teacher value 2 marks</p> <p>average titre is within 2.5% of teacher value 1 mark</p>	<p>(A) 4</p>	<p>If a candidate has two concordant titres then both concordancy and accuracy marks can be awarded.</p> <p>If a candidate does not have two concordant titres but does have two titres within 0.20 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 0.20 cm³ cannot receive concordancy or accuracy marks.</p> <p>Check that the candidate has calculated the average titre correctly. If not, calculate the correct average and base the candidate's accuracy mark on the correct average. The candidate does not have to use all of the concordant titres in obtaining an average.</p> <p>If a candidate has one set of concordant results, and has correctly identified these results, base the accuracy mark on the candidate's average titre.</p> <p>A candidate may have one set of concordant results, but uses a non-concordant titre in calculating the average. Average all of the candidate's concordant titres, and use this average to determine the mark for accuracy.</p> <p>A candidate may have two sets of concordant results, which do not overlap. The teacher should choose the set of concordant titres that gives the higher accuracy mark, even if the candidate chooses the other set. Allow a correct calculation of an average titre for either set of concordant results.</p> <p>Do not penalise a candidate who has done more than five titrations.</p> <p>If the initial burette reading is given as 50.00, and the final titre reading is given as, say, 22.30 the titre could be 22.30 or 27.70. Use the value which gives the candidate the higher accuracy mark.</p>
<p>Total</p>	<p>7</p>	

CHM6X Written Test - Section A Ignore absence of units unless units are required in the Marking Guidelines.
Incorrect units lose the mark

Question	Marking Guidelines	Mark	Additional Guidance
1	States that results for weedkiller match those for Fe ²⁺ or uses appropriate observation for named test to identify Fe ²⁺	1	Decision must correspond to candidate's results. Allow consequential answer from candidate's results.
2	Test barium chloride / nitrate and hydrochloric acid / nitric acid Observation white precipitate	1 1	Do not allow 'acidified barium chloride'. Penalise incorrect formula. Allow if barium salt used without acid. If wrong test then lose second mark.
3	Calculates the correct average titre using concordant results only	1	Do not penalise precision.
4	$5\text{Fe}^{2+} + \text{MnO}_4^- + 8\text{H}^+ \rightarrow 5\text{Fe}^{2+} + \text{Mn}^{2+} + 4\text{H}_2\text{O}$	1	Accept multiples including fractions.
5	Moles Fe ²⁺ = (answer to Q3) x 0.02 x 10 ⁻³ x 5	1	Do not penalise precision.
6	Concentration = answer to Q5 x 40 Answer even if incorrect, given to 3 significant figures	1 1	
7(a)	277.9	1	Lose this mark if answer not given to 1 decimal place.
7(b)	Answer to Q6 x answer to Q7(a)	1	Do not penalise precision.

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8(a)	$\text{NH}_4^+ \rightarrow \text{NH}_3 + \text{H}^+$	1	Accept multiples. Accept $\text{NH}_4^+ + \text{H}_2\text{O} \rightarrow \text{NH}_3 + \text{H}_3\text{O}^+$ Ignore state symbols, even if incorrect.
8(b)	Test indicator/ conc HCl	1	Do not accept 'smell'. Do not accept precipitation reactions of aqueous ammonia.
	Observation colour for an alkali / white fumes	1	If wrong test then lose second mark.
9	MnO_4^- will oxidise the <u>chloride</u> ion/ reaction of MnO_4^- and Cl^- feasible	1	Accept converse argument with $\text{Cr}_2\text{O}_7^{2-}$ Accept calculations of overall E^\ominus values.
	Larger volume needed	1	
Total		15	

**CHM6X Written Test - Section B Ignore absence of units unless units are required in the Marking Guidelines.
Incorrect units lose the mark**

Question	Marking Guidelines	Mark	Additional Guidance
10(a)	Idea that <u>over time / after storage</u> meter does not give accurate readings	1	Do not accept 'to get an accurate reading' without further qualification. Allow 'temperature variations affect reading'.
10(b)	$\frac{[\text{Fe}(\text{H}_2\text{O})_5\text{OH}]^{2+}(\text{aq}) [\text{H}^+(\text{aq})]}{[\text{Fe}(\text{H}_2\text{O})_6]^{3+}(\text{aq})}$	1	Allow without (aq) symbols. Need at least one set of square brackets around complex. ions
10(c)	pH = -log [H ⁺] [H ⁺] = 0.0240 $K_a = (0.0240)^2 / 0.1 = 5.75 \times 10^{-3}$ or 5.76×10^{-3} Answer, even if incorrect, given to 3 sig figs	1 1 1 1	Do not penalise precision of [H ⁺] Correct answer scores M1 and M2. Correct answer without working loses M1 and M2. Allow 7.58×10^{-3}
10(d)	Oxygen (in the air) / O ₂	1	Ignore 'air' or 'the atmosphere' or 'chemicals in soil'. List principle.
10(e)	4.0 - 6.9		Do not penalise precision.
11(a)	$\text{Fe} + \text{H}_2\text{SO}_4 \rightarrow \text{FeSO}_4 + \text{H}_2$	1	Accept multiples. Ignore state symbols, even if incorrect.

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11(b)	Hazard	acid corrosive or hydrogen flammable / explosive	1	Accept 'iron(II) sulfate/ sulfuric acid an irritant'. Allow 'if reagent contacts skin wash off immediately' or answers to that effect instead of gloves. Do not allow 'wipe up spillages'. Ignore 'lab coat' or 'use of fume cupboard' or 'do not ingest chemicals'.
	Precaution	gloves or eye protection or avoid naked flames / spark	1	
12(a)	Plots all of the points correctly \pm one square Straight line through the points is best fit		1	Candidate does not have to extrapolate line to the origin. Line must pass through the origin \pm 1 square. Lose this mark if the candidate's line is doubled or kinked. Allow line that doesn't pass through the origin if one or more points are misplotted.
			1	
12(b)		$7.6 \pm 0.1 \times 10^{-2} \text{ (mol dm}^{-3}\text{)}$	1	Do not penalise precision, but at least 2 significant figures.
12(c)		To intensify colour / to increase absorbance	1	
Total			15	

CHM6X Written Test - Section C Ignore absence of units unless units are required in the Marking Guidelines.**Incorrect units lose the mark**

Question	Marking Guidelines	Mark	Additional Guidance
13(a)	K_c / K_a / <u>equilibrium constant</u> / <u>constant</u> is temperature dependent	1	Do not allow 'affects or shifts equilibrium'.
13(b)	Thermostat / water bath	1	
14	Flask with side arm in appropriate place	1	If apparatus not air-tight maximum 1 mark.
	Suitable funnel and filter paper	1	
15	1-chloropropane no visible change	1	Accept 'small amount of precipitate' or 'precipitate forms slowly'. Accept 'large amount of precipitate' or 'precipitate forms immediately'.
	ethanoyl chloride white precipitate	1	
Total		6	

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