

Version 1.2



General Certificate of Education (A-level)
June 2011

Chemistry

CHM3X

(Specification 2420)

**Unit 3X: Investigative and practical skills in AS
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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CHM3X Task 1 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 'Initial reading', 'Final reading' etc are not needed in this very familiar table.</p> <p>If the initial burette reading is given as 50 then R = 0</p>
All titre volumes to 0.05 cm ³	(P) 1	Allow zero entries as 0 or 0.0
Concordant if two titres are within 0.10 cm ³ of each other	(C) 1	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>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 average titre is within 1.5% of teacher value 3 marks average titre is within 2% of teacher value 2 marks 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>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>	

CHM3X 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.
<p>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 white precipitate" then scoring point is not awarded.</p>			
1	NaOH solution no visible change	(A) 1	Accept no change, no reaction, stays the same or colourless solution
2	H ₂ SO ₄ solution white precipitate	(A) 1	Accept suspension, sediment, solid (deposit) as well as precipitate. Do not accept cloudy, misty or emulsion Penalise reference to white solution (once only)
3	K ₂ CrO ₄ and HCl solutions yellow precipitate	(A) 1	Accept suspension, sediment, solid (deposit) as well as precipitate Do not accept cloudy, misty or emulsion Ignore reference to yellow solution
	yellow / orange solution	(A) 1	Accept precipitate dissolves or disappears
4	AgNO ₃ and HNO ₃ solutions no visible change	(A) 1	Accept no change, no reaction, stays the same or colourless solution

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5	Na ₂ CO ₃ solution	white precipitate	(A) 1	Accept suspension, sediment, solid (deposit) as well as precipitate Do not accept cloudy, misty or emulsion Penalise any reference to effervescence
Total			7	

CHM3X 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	Calculates the correct average titre using concordant results only	1	Do not penalise precision.
2	$\text{HA} + \text{NaOH} \rightarrow \text{NaA} + \text{H}_2\text{O}$	1	Accept multiples and ionic equations.
3	$2.5(0) \times 10^{-3}$	1	Do not penalise precision.
4	Moles acid = answer to Q3 Concentration = moles acid x 1000 / answer to Q1 Answer to 3 sig figs	1 1 1	Correct answer to 3 sig figs scores 3 marks. Correct answer with incorrect precision scores 2 marks. Mark precision independently of final answer.
5	8.00 / answer to Q4	1	Lose this mark if answer not given to 1 decimal place. Using 0.106 gives 75.5 Allow answer in g or g mol^{-1}
6	Correctly calculates n consequentially from answer to Q5	1	Accept decimal or nearest whole number. Using 75.5 gives $n = 2(.07)$ (Note that $M_r = 81$ is where n changes from 2 to 3)

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7	Pipette $(0.05 \times 100) / 25 = 0.2\%$	1	Do not penalise precision.
	Burette $(0.15 \times 100) / \text{answer to Q1}$	1	Lose mark if the burette error is not calculated on Q1 Two correct errors without working or incomplete working scores one mark only.
8(a)	Blue to green	1	Accept blue to yellow.
8(b)	Decrease / less acid needed	1	Ignore references to rate
8(c)	Gloves or avoid skin contact	1	Allow 'if reagent contacts skin wash off (immediately)' or answers to that effect. Do not accept 'wash' only. Ignore 'eye protection' or 'lab coat' or 'use of fume cupboard' or 'don't ingest'.
8(d)	Less chance of losing liquid on swirling / liquid doesn't splash on swirling	1	Do not accept 'easier to swirl' on its own. Do not accept 'easier to stir'.

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8(e)	Idea that a single titration could be flawed / anomalous	1	Allow an indication that the first titration is a rough titration. Do not allow 'to improve accuracy' without qualification. Do not allow vague references to 'outliers'.
9(a)	$2.3(3) \times 10^{-2}$	1	Do not penalise additional significant figures, but do not allow 0.02
9(b)	Dilution of acid needed / may react with carbon dioxide in air	1	Accept 'poor end-point' or 'no suitable indicator' or 'a large volume (of calcium hydroxide) will be needed'. Ignore references to low solubility or concentration too low.
10	Barium or strontium (as name, symbol or correct ion) White precipitate with H_2SO_4	1 1	If white precipitate in Task 2 Test 1 and Test 2, allow calcium White precipitate with NaOH or H_2SO_4
11	If candidate has no visible change in Task 2 Test 1 <ul style="list-style-type: none"> • Can confirm since no precipitate with NaOH • Magnesium hydroxide insoluble (or would form white precipitate) or If candidate has white precipitate in Task 2 Test 1 <ul style="list-style-type: none"> • Can't confirm since white precipitate with NaOH or Na_2CO_3 • Magnesium hydroxide / carbonate insoluble (or would form white precipitate) 	1 1	No mark allocated but rest of answer must correlate.
Section A Total		21	

CHM3X 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
12	Remove undissolved barium hydroxide / <u>excess</u> solid	1	Do not accept 'remove impurities'.
13	Filtration	1	Do not accept 'decanting' or 'sieving'. Ignore references to heating or drying.
14	Remove (excess) sulfuric acid	1	
15	$\text{Ba(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O}$	1	Accept multiples. Accept $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$ Ignore state symbols.
16(a)	233.4	1	Accept 233 if precision penalised in Q5
16(b)	0.018(2)	1	Do not penalise additional significant figures, but do not allow 0.02 Allow consequential answer from Q16(a).

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16(c)	$0.018(2) \times 171.3 = 3.12$ $\times 10 = 31.2$	1 1	Do not penalise precision. If 0.018 used, answer = 3.08 Do not penalise precision. Allow this mark if 0.18(2) used directly. Correct answer without working scores one mark only. Allow consequential answer on 16(b)
17	Barium sulfate / it is insoluble	1	Do not accept answers based on small amount ingested. Do not accept barium.
Section B Total		9	

CHM3X Written Test - Section C

Question	Marking Guidelines	Mark	Additional Guidance
18(a)	Test bromine (water) / iodine	1	Accept 'Br ₂ ' or 'bromine in a named solvent'. Do not accept 'Br' Use of UV light, CE (lose next mark as well)
18(b)	Observation orange / yellow / (red-)brown to colourless	1	Must have correct reagent in Q18(a) to score this mark. For I2, allow red-brown/purple to colourless.
19	Include washings or words to that effect / mix contents	1	Accept 'use distilled / deionised water'. Allow 'weigh directly into flask' if washing included.
20(a)	To ensure that other (an)ions do not interfere	1	Accept 'to prevent other salts precipitating'. Accept 'to remove carbonate / hydroxide (ions)'.
20(b)	<u>Concentrated</u> (ammonia)	1	'Precipitate partially soluble in dilute ammonia' scores both marks.
	Precipitate soluble / dissolves	1	
Section C Total		6	

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