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General Certificate of Education (A-level)
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Chemistry

CHM3T/P13

(Specification 2420)

Unit 3T: Practical and Investigative Skills

Investigative Skills Assignment

Final

Marking Guidelines

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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Guidance for teachers marking Chemistry ISAs

Final Marking Guidelines must be used to mark students' work.

General principles

In general, you are looking for evidence that the student knows and understands the key idea required by the Marking Guidelines.

It is important to mark what the student has written, not to assume what may have been intended. It is also important to make sure that a valid point is in the correct context. Individual words or phrases where the overall answer does not apply to the question asked should not be credited.

Conventions

The following conventions are used in the Marking Guidelines.

- An oblique stroke (/) separates alternatives within a marking point.
- Underlining of a word or phrase means that the term must be used.
- Brackets are used to indicate contexts for which a marking point is valid. This context may be implied by a student's answer.
- 'Accept' shows answers that have been allowed.
- 'Max' refers to the maximum mark that can be awarded for a particular question.

The Marking Guidelines show the minimum acceptable answer(s) for each marking point. A better, more detailed, or more advanced answer should always be accepted, provided that it covers the same key ideas.

Marking Guidelines cannot give every possible alternative wording - equivalent phrasing of answers should be accepted. It is, however, important to be sure that the minimum requirement of the Marking Guidelines is met and that the point is made unambiguously.

Converse answers are normally acceptable, unless the wording of the question rules this out. For example, 'an increase in pressure favours the forward reaction' or 'a decrease in pressure favours the backward reaction'.

Occasionally, a student will give a chemically correct answer that is not present in the Marking Guidelines. If it is equivalent in standard to the Marking Guideline answers, it should be credited. In this case, write the word 'valid'.

All marking points are awarded independently, unless a link between points is specified in the Marking Guidelines.

The mechanics of marking

Always mark in red ink. Make sure that some red ink appears on every page on which the student has written.

For each mark awarded, put a tick close to the key word or phrase. In all cases, a tick should equal one mark and the total number of ticks should match the mark given for that question. The teacher should write the total mark in the margin.

Put a cross against incorrect points. It is helpful to indicate omissions of key words or incomplete answers with a **Λ** symbol, and to highlight irrelevancies or contradictions etc by underlining. It may also be helpful to write brief comments to explain the reason for awarding or withholding a mark when the answer does not obviously match the Marking Guidelines.

When marking answers with many marking points, the points do not have to appear in the order in which they appear in the Marking Guidelines unless stated otherwise.

Chemical Error

Occasionally, an answer involves incorrect chemistry and the Marking Guidelines records CE = 0, which means a chemical error has occurred and no credit is given for that part.

Disqualifiers

A correct point should be disqualified when the student contradicts it in the same answer. Indicate by 'dq'. If a tick has already been placed against a valid point, ensure that it is clearly deleted. Note that there is no penalty for incorrect points which are not contradictory, nor for surplus or neutral information.

The list rule

When a question asks for a specific number of points, and the student gives more, the general rule is that any wrong answer cancels a correct answer. For example, if a question asks for two points and three answers are given, two correct and one clearly wrong, the mark awarded is one, whatever the order of the answers. This prevents students from gaining full marks from a list of right and wrong answers.

'Neutral' points

ie ones which are not creditworthy but not actually incorrect, should not negate a correct answer. For example, in answer to 'Name **two** physical properties of metals' a student may give:

'Good conductor of electricity, solid, high density'.

In this case, one mark would be awarded for 'good conductor of electricity' and one for 'high density'. 'Solid' is a neutral point and should be ignored.

Two correct points on the same answer line should be credited.

Spelling

Reasonably close phonetic spellings should be credited.

Precision

In questions where students are **not** asked to give an answer to the appropriate precision, answers given with more precision than expected are not penalised. Answers given to a precision less than that indicated in the Marking Guidelines must be penalised.

Rounding

Incorrect rounding of calculations must be penalised, but only once per paper.

Crossed out work

When considering crossed out work, **mark it** as if it were not crossed out **unless** it has been replaced by a later version; this later version then takes priority.

Task Assessment

Marking Guidelines	Mark	Additional Guidance
Student reads the burette correctly	(B) 1	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, with all titres calculated correctly	(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 of a table box.</p> <p>Lose this mark if the initial reading is recorded as 50.0 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 five titrations.</p>
All volumes recorded to 0.05 cm ³	(P) 1	<p>For example, accept 20.30 and 20.35 but do not accept 20.3, 20.31, 20.32 etc.</p> <p>Allow zero entries as 0 or 0.0</p> <p>If a set of readings are labelled 'rough' or 'trial' etc. ignore their precision unless the titre is used in calculating the average.</p>

<p>Concordant if two titres are within 0.10 cm^3 of each other</p>	<p>(C) 1</p>	<p>Award the mark for concordancy if the table contains at least two concordant titres, 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>Titres which differ from each other by more than 0.20 cm^3 cannot receive concordancy or accuracy marks</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 accuracy marks can.</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. There will be a penalty for an incorrect calculation of the average titre in Q1 of the Written Test.</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 results, but uses a non-concordant titre in calculating the average. Average all of the student's concordant titres, and use this average to determine the mark for accuracy. There will be a penalty for including a non-concordant titre in calculating the average in Q1 of the Written Test.</p>

		<p>A student 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 student chooses the other set. Allow a correct calculation of an average titre for either set of concordant results.</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>If most students score low marks for accuracy, contact your Assessment Adviser.</p>
Total	8	

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	Average titre value using at least two concordant results	1	Do not penalise precision of average titre. Do not award to student given Teacher Results. Allow a correct calculation of an average titre for any set of concordant results, even from incorrect arithmetic in the Task table. 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. If there are no concordant results, lose this mark.
2	$Q1 \times 0.100 / 1000$	1	Do not penalise precision but must be to minimum of two significant figures.
3	$Q2 / 2$	1	Do not penalise precision but must be to minimum of two significant figures.
4	$Q3 \times 1000 / 25$ OR $Q3 \times 40$ Correct answer based on Q3 Answer to three significant figures	1 1 1	Lose this mark if no / incorrect / incomplete working shown. Award this mark independently even if the concentration is incorrect.

5(a)	Concentration of solution $Y = 14.3 \text{ g dm}^{-3}$	1	Allow 71 / 5 Do not penalise precision. Ignore units.
	$M_r = 14.3 / Q4$	1	Allow answer in g. If Q4 alternative answer used, then $M_r = 293.6$ Accept answers correctly rounded to the nearest integer value. Only allow 2 marks for the correct answer if some correct working is shown.
5(b)(i)	$x = (Q5(a) - 106) / 18$	1	Lose this mark if answer not to 1 decimal place. If Q4 alternative answer used, then $x = 10.4$
5(b)(ii)	$286.0 \times 0.99 = 283.1$	1	Do not penalise precision. Accept answers correctly rounded to the nearest integer value. Ignore units.
	$x = 9.8$	1	Lose this mark if answer not to 1 decimal place.
5(c)	Loss of <u>water</u> / <u>H₂O</u> / <u>moisture</u> from the sample / efflorescence	1	Answer must refer to loss of water. Allow 'water evaporates'. Ignore references to decomposition or mis-labelling.
6(a)	Solution Y must have been in the burette / hydrochloric acid must have been pipetted	1	Allow statements that imply the contents of the burette and pipette have been switched.
6(b)	Volume of acid is 25 cm^3 / volume of sodium carbonate is the (average) titre / swap volumes in the calculation / swap concentrations in the calculation	1	Any implication that the results cannot be used loses the mark.

7	Eye protection must be worn	1	Ignore references to gloves. Do not award this mark if any other precaution accompanies eye protection.
Total		15	

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
8(a)	'Initial mass' must be the <i>y</i> -axis	1	If axis unlabelled, use data to decide that 'Initial mass' is on the <i>y</i> -axis.
	Sensible scale	1	Do not award this mark if plotted points do not cover at least half of the grid. Do not award this mark if any plotted point is outside the grid.
	All points plotted correctly	1	Allow \pm one small square.
	Point at (0,0) is ringed	1	
8(b)	Best-fit straight line that goes through the origin \pm $\frac{1}{2}$ small square	1	Mark consequentially to plotted points but the line must still go through the origin \pm $\frac{1}{2}$ small square. Lose this mark if the line is doubled or kinked. If the points are plotted correctly, lose this mark if the line deviates towards the anomalies.
8(c)	Students 3 and 5	1	Allow masses of 1.15 and 1.53 or 2.82 and 3.58 Mark consequentially to plot.
8(d)	Samples 3 or 5 have not lost all their water	1	Allow reaction / decomposition incomplete.
	Sample not heated for enough time / larger masses will take a longer time to dehydrate / decompose	1	

9(a)	(CO ₂ from) burning (fossil) fuels	1	
9(b)	$\text{NaCl} + \text{CO}_2 + \text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$	1	Allow multiples, including fractions. Ignore state symbols.
9(c)	$\text{CaO} + 2\text{NH}_4\text{Cl} \rightarrow \text{CaCl}_2 + 2\text{NH}_3 + \text{H}_2\text{O}$	1	Allow multiples, including fractions. Allow ionic equations. Do not allow equations involving NH ₄ OH or NH ₄ ⁺ on the right hand side. Ignore state symbols.
9(d)(i)	= (106) x 100 / (117 + 100(.1)) = 48.8	1	Do not penalise precision but must be to minimum of two significant figures.
		1	This answer without working scores 1 mark only.
9(d)(ii)	The percentage atom economy cannot be improved OR Sell the by-product / CaCl ₂ (solution)	1	Do not accept answers which refer to improving the efficiency of the process.
9(e)	It is used up but then regenerated later in the cycle / No overall consumption of NH ₃	1	Allow 'can act as a catalyst'.
Total		15	