A-level

Chemistry

Investigative and Practical Skills in AS Chemistry - CHM3T/P14
Final Marking Guidelines

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

Guidance for teachers marking Chemistry ISAs

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. Where 'significant figures' are required leading zeros must be ignored before the numbers begin eg 3 significant figures would include 3.46, 12.6, 0.134 and 0.0345 but not 25.69, 0.16 or 0.05.

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.

Stage 1 Assessment (Task)

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	(R) 1	If you can read it, it is clear. 'Full' means the table must have 'Initial reading', 'Final reading' and 'Titre values' for at least two sets of results. Labels such as 'Initial reading', 'Final reading' etc are not essential. The table does not have to have gridlines. Allow a clear answer outside of a table box. Lose this mark if the initial reading is recorded as 50.0 cm^3. Lose this mark if there is an arithmetic error in calculating a titre. Do not penalise missing units but lose this mark if units are incorrect. Do not penalise a student who does more than five titrations. Errors in recording the final titre are not penalised here but may be penalised in the Written Test.

All titre volumes to 0.05 cm^3	(P) 1	For example, accept 20.30 and 20.35 but do not accept 20.3, 20.31, 20.32 etc. Allow zero entries as 0 or 0.0 If a set of readings are labelled 'rough' or 'trial' etc, ignore their precision unless the titre is used in calculating the average.

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 the student has not recognised these as concordant titres. Do not award this mark if two concordant results are only achieved by incorrect arithmetic. Can score concordancy mark if titre volumes are only recorded to 1 decimal place but will lose Precision mark.

The accuracy of the student's average titre, measured against a teacher value for the titration This mark can be awarded independent of precision 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 There is no penalty in the task for an incorrectly calculated average titre	(A) 4 3 2 1	If a student has two concordant titres then both concordancy and accuracy marks can be awarded. 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. Titres which differ from each other by more than 0.20 cm^3 cannot receive concordancy or accuracy marks. 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

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		Q1 of the Written Test. 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. 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. 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. 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. If most students score low marks for accuracy, contact your Assessment Adviser.

Total	**8**

Stage 2 Assessment (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	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 either set of two sets of concordant results but not if all sets (or a majority) are averaged. 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. Lose this mark if there are no concordant results.
2	2.46×10^{-3}	1	Correct answer without working scores this mark. Allow 2.5×10^{-3} Do not allow 2×10^{-3} or 3×10^{-3}
3	Q2 × 1000 / answer from Q1 Correctly calculates concentration	1 1	Allow use of $(M_1V_1) = M_2V_2$ Correct answer without working scores 1 mark only. Lose this mark if not to 3 significant figures.

4	Q3 × 40(.0)	1	Do not penalise precision but answer must be to at least 2 significant figures. Correct answer without working scores this mark. Student may use own value from Q3 or 0.135 Using 0.135 gives 5.4(0)
5	(conc. = 40 × 0.395 =) 15.8 g dm^{-3} ((15.8 - Q4) × 100) / 15.8	1 1	Allow 15.8 Allow mass of NaOH in 25 cm^3 = Q4/40 Allow percentage = ((0.395 – Q4/40) × 100) / 0.395 Allow any correct alternative method. Do not penalise precision but answer must be to at least 2 significant figures. Correct answer without working scores 1 mark only. Using 5.40 from Q4 gives 65.8%
6	Sodium chloride does not react with HCl /NaOH or sodium chloride has no acid / base properties or sodium chloride is a product of the reaction	1	Do not allow 'sodium chloride does not react' without further qualification. Ignore 'sodium chloride is neutral'. Ignore 'sodium chloride solution has pH =7'. Allow 'sodium chloride has no effect on the indicator'.
7	0.2 + (0.15 × 100) / Q1	1	Do not penalise precision.

8(a)	Space will fill during titration / titres or volumes added are too high	1	Do not allow 'to improve accuracy' without qualification. Do not allow 'incorrect end-point' without qualification. Do not allow 'titres or volumes added are too low'. Ignore 'titres or volumes added are different'.
8(b)	Less chance of losing liquid on swirling / liquid doesn't splash on swirling	1	Do not accept 'easier to swirl' on its own.
8(c)(i)	Returns reagent on the sides of the flask to the reaction mixture (to ensure that all of the acid / alkali reacts)	1	Do not allow 'to improve accuracy' without qualification. Ignore reference to cleaning.
8(c)(ii)	This does not change the number of moles of reagents / water is not a reagent / water is one of the products	1	Do not allow 'water does not affect the titration' without qualification. Ignore 'water is neutral / has a pH of 7'.
8(d)	Idea that a single titration could be flawed / anomalous	1	Do not accept 'will improve reliability / reproducibility / accuracy' without further qualification. Allow 'to obtain concordant results'.
9	Divides percentage by price Dub-Lit Brick Cleaner is the best value	1	Ratios are 1.668, 1.701 and 1.437 Allow if divides price by percentage (ratios are 0.600, 0.588 and 0.696). Lose mark if no working shown or contains an arithmetic error.

10	Total volume = (10 × 12) / 0.25 = 480 (cm^3) **M1**	1	Allow any correct method.
	Therefore add 470 (cm^3) **M2**	1	For **M2**, allow **M1** – 10, even if **M1** is incorrect. Correct answer without working scores 1 mark only.

Total	**17**

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
11(a)	Uses sensible scales	1	Lose this mark if the **plotted points** do not cover half of the paper. Lose this mark if the graph plot goes off the squared paper.
	Plots **all** of the points correctly ± one small square	1	
	Draws a best-fit line	1	Lose this mark if the student's line includes either of the points at 0.5/0.48 or 3.5/2.28 Lose this mark if the student's line is doubled or kinked. Lose this mark if the student's line does not pass within one small square of the origin, extending the line if necessary.
11(b)	1.38 to 1.47	1	Allow answer in this range only. Answer must correspond to value from the student's graph.
11(c)	**M1** Moles NaOH = 1.00/40 and Moles water = (Q11(b) - 1) / 18	1	Allow any correct method which uses the answer from Q11(b).
	M2 Ratio NaOH : H_2O is close to 1:1	1	Must compare experimental result with theoretical result to score **M2**.
12(a)	**2**NaOH + **2**Al + **6**H_2O → **2**$NaAl(OH)_4$ + **3**H_2	1	Ignore state symbols.

12(b)	Pressure build-up due to the production of hydrogen / H_2 / gas	1	Ignore references to the flammability / explosive nature of hydrogen.
13	(Alkali is) corrosive / caustic	1	Allow '(alkali) burns skin'. Ignore 'harmful', 'dangerous'. Do not allow 'toxic' or 'irritant'.
14(a)	Other product in equation is water $(NH_4)_3PO_4$ + **3**NaOH → Na_3PO_4 + **3**NH_3 + **3**H_2O	1 1	If product incorrect, CE = 0/2 Allow multiples, including fractions. Ignore state symbols.
14(b)	Named indicator paper placed in gas / add named indicator to gas / collect gas and add named indicator Correct full colour change	1 1	If indicator not named, CE = 0/2 Lose this mark if the indicator is added to the reaction mixture. Can still score the second mark. If universal indicator is used, allow 'green to blue / purple' or 'yellow to blue / purple'. If litmus is used, allow 'purple to blue' or 'red to blue'. Allow one mark overall for 'add universal indicator' and 'turns purple / blue'. Allow one mark overall for 'add litmus' and 'turns blue'.

Total	**13**