Chemistry 2025 v1.2

IA1 sample marking scheme

June 2025

Data test (10%)

This sample has been compiled by the QCAA to model one possible approach to allocating marks in a data test. It matches the examination mark allocations as specified in the syllabus (~ 30% apply understanding, ~ 30% analyse data and ~ 40% interpret evidence) and ensures that a balance of the objectives are assessed.

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

2. Apply understanding of chemical equilibrium systems or oxidation and reduction to given algebraic, visual or graphical representations of scientific relationships and data to determine unknown scientific quantities or features.
3. Analyse data about chemical equilibrium systems or oxidation and reduction to identify trends, patterns, relationships, limitations or uncertainty in datasets.
4. Interpret evidence about chemical equilibrium systems or oxidation and reduction to draw conclusions based on analysis of datasets.

Note: Objectives 1, 5 and 6 are not assessed in this instrument.

Queensland Government
QCAA Queensland Curriculum & Assessment Authority
For all Queensland schools
250569

Instrument-specific marking guide (IA1): Data test (10%)

Data test	Cut-off	Marks
The student response has the following characteristics:		
• consistent demonstration, across a range of scenarios, of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct and appropriate use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions	>90% >80%	10 9
• consistent demonstration of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions	>70% >60%	8 7
• adequate demonstration of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual and graphical representations of scientific relationships and data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations and uncertainty – correct interpretation of evidence to draw valid conclusions	>50% >40%	6 5
• demonstration of elements of – selection and correct application of scientific concepts, theories, models and systems to predict outcomes, behaviours and implications – correct calculation of quantities through the use of algebraic, visual or graphical representations of scientific relationships or data – correct use of analytical techniques to correctly identify trends, patterns, relationships, limitations or uncertainty – correct interpretation of evidence to draw valid conclusions	>30% >20%	4 3
• demonstration of elements of – application of scientific concepts, theories, models or systems to predict outcomes, behaviours or implications – calculation of quantities through the use of algebraic or graphical representations of scientific relationships and data – use of analytical techniques to identify trends, patterns, relationships, limitations or uncertainty – interpretation of evidence to draw conclusions.	>10% >1%	2 1
The student response does not match any of the descriptors above.		0

Task

See the sample assessment instrument for IA1: Data test (10%) (available on the QCAA Portal).

Sample marking scheme

Criterion	Marks allocated	Provisional marks
Data test Assessment objectives 2, 3, 4	10	—
Total	**10**	**—**

Marking scheme symbols and abbreviations

Symbol or abbreviation	Meaning
✓	The preceding section of the expected response is worth one mark.
/	Separates acceptable alternative wordings in the expected response.
()	Terms in brackets are not necessary in the response for the mark to be awarded.
shaded and underlined text	Shaded and underlined text must be included in the response for the mark to be awarded.
Accept converse	Award the mark even if the answer is stated in its converse form, e.g. 'A comes before B' can be stated as 'B comes after A'.
Accept min–max	Award the mark for any numerical answer that falls within the specified range, e.g. 'Accept 1.5–1.9' means that any answer between 1.5 and 1.9 should be considered correct. This is used in questions that involve a multi-step calculation where differences in rounding in the intermediate steps could result in slight differences in the final answer.
Allow for FT error	Means 'allow for follow-through error'. Initial errors should only be penalised once. Marks should be awarded for subsequent steps that are correct.
Allow FT error for transcription only	Follow-through error is only allowed if the student has written down information incorrectly but processed it correctly.
AND	Separates two parts of the response that are both required for the mark to be awarded.
Max # marks	The maximum number of marks that can be awarded for the question is indicated by #.
OR	Separates acceptable alternative wordings.
OWTTE	Means 'or words to that effect'. This is used in questions where students are unlikely to use the exact wording given in the expected response. If the student's response has the same meaning as the expected response, then the mark should be awarded.
Working not required	Evidence of working, reasoning or calculations is not required for the mark to be awarded.

The annotations are written descriptions of the expected response for each question and are related to the assessment objectives.

Assessment objective	Marking scheme	Mark allocation
		Note: ✓ = 1 mark
Apply understanding The question uses the cognitive verb 'determine'. The expected response is an unknown scientific quantity.	**Question 1 (1 mark)** 9.2 ✓	1 mark for correct pH. Accept 9.1–9.3
Apply understanding The question uses the cognitive verb 'determine'. The expected response is an unknown scientific quantity.	**Question 2 (1 mark)** pK_b = 14 − 9.2 = 4.8✓	1 mark for correct pK_b. Allow FT mark for pK_b. correctly calculated from incorrect pH of half-equivalence point from Question 1.
Analyse data The question uses the cognitive verb 'contrast'. The expected response identifies a relationship.	**Question 3 (2 marks)** pH at half equivalence is 9.2 while the pH at the equivalence point is 5.3. ✓ OR The pH at the half equivalence point is 9.2, which is higher than 5.3, which is the pH at the equivalence point. ✓	1 mark for determining pH at equivalence point and contrasting between it and the pH at half-equivalence. Accept 5.2–9.4 for pH at equivalence point.
	Volume of HCl at equivalence point is 17.6 cm^3 and $(\frac{17.6}{2})$ 8.8 cm^3 ay the half equivalence point. ✓ OR The volume of HCl at the half equivalence point is 8.8 cm^3, which is half the volume at the equivalence point.✓	1 mark for correct volume at equivalence point and contrasting between it and the volume at half-equivalence. Units not required.
Interpret evidence The question uses the cognitive verb 'deduce'. The expected response draws a conclusion based on analysis.	**Question 4 (2 marks)** Methyl red✓	1 mark for correct indicator. Allow for FT mark for correct indicator choice based on incorrect pH at equivalence from Question 3.
	pH equivalence point falls within the end point / pH range of the indicator.✓	1 mark for justification of choice of indicator.

Apply understanding The question uses the cognitive verb 'calculate'. The expected response is an unknown scientific quantity.	**Question 5 (3 marks)** Moles of ammonia in aliquot of diluted cleaning product = moles of HCl at equivalence = 0.100 × 17.6 / 1000 = 0.001 76 mol✓ (1.76×10^{-3} mol) Concentration of ammonia in the aliquot of diluted cleaning product $= \frac{0.001\,76}{0.025}$ = 0.0704 mol dm^{-3}✓ Concentration of ammonium in undiluted cleaning product = 0.0720 × 50 (dilution factor) = 3.52 mol dm^{-3}✓	1 mark for calculating moles of HCl at equivalence point. Accept 0.00175–0.00177. 1 mark for calculating concentration of ammonia in the aliquot. Allow FT mark for correctly calculating concentration based on incorrect moles HCl. 1 mark for calculating concentration of ammonium in undiluted cleaning product. Allow FT mark for correctly calculating [NH_3] based on incorrect moles HCl. Units not required.
Analyse data The question uses the cognitive verb 'sequence'. The expected response identifies a relationship.	**Question 6 (3 marks)** A, C, B, D ✓ Metal A displaces all metal ions from solution; therefore, it is the most reactive. OR Metal D displaces no metal ions from solution; therefore, it is the least reactive. ✓ C displaces $B^{2+}_{(aq)}$ and $D^{+}_{(aq)}$ from solution but not A^{2+}; therefore, C is more reactive than B and but less reactive than A. ✓	1 mark for correct reactivity series. 1 mark for reasoning for A being most reactive OR D being least reactive. 1 mark for reasoning for C being more reactive than B.
Apply understanding The question uses the cognitive verb 'identify'. The expected response is an unknown scientific feature.	**Question 7 (1 mark)** Voltaic cell 3 OR $A_{(s)}$ I $A^{2+}_{(aq)}$ II $D^{+}_{(aq)}$ I $D_{(s)}$✓	1 mark for correct voltaic cell.
Analyse data The question uses the cognitive verb 'identify'. The expected response identifies a relationship.	**Question 8 (1 mark)** The greater the difference in the reactivity of the metals, the greater the voltage produced by the voltaic cell. ✓	1 mark for correct relationship. Do not allow for FT error from Question 6.

Interpret evidence The question uses the cognitive verb 'deduce'. The expected response draws a conclusion based on analysis.	**Question 9 (2 marks)** A voltaic cell constructed using metals B and C as electrodes would produce a smaller potential difference than voltaic cell 1. ✓ C is less reactive than A because only one ion (D^{2+}) is displaced from solution and therefore closer to B on the activity series than A.✓	1 mark for deducing that the potential difference would be smaller. 1 mark for reason. Accept converse. Do not allow for FT error from Question 6.
Interpret evidence The question uses the cognitive verb 'predict'. The expected response draws a conclusion based on analysis.	**Question 10 (2 marks)** C would be oxidised (and B would be reduced). ✓ C would be oxidised because it displaces two metal ions from solution and therefore, is more reactive than B. ✓	1 mark for identifying that C would be oxidised. 1 mark for reason. Do not allow for FT error from Question 6.
Interpret evidence The question uses the cognitive verb 'deduce'. The expected response draws a conclusion based on analysis.	**Question 11 (2 marks)** Oxidation: $C_{(s)} \rightarrow C^{+}_{(aq)} + e^{-}$ AND Reduction: $B^{2+}_{(aq)} + 2e^{-} \rightarrow B_{(s)}$ OR $C_{(s)} + B^{2+}_{(aq)} \rightarrow B_{(s)} + C^{+}_{(aq)}$ ✓ $2C_{(s)} + B^{2+}_{(aq)} \rightarrow B_{(s)} + 2C^{+}_{(aq)}$ ✓	1 mark for correct half equations or unbalanced equation. Allow for FT error from Question 10. 1 mark for balancing the equation. Do not penalise if states are missing.