

Assessment Report

New Zealand Scholarship Chemistry 2025

Performance standard 93102

General commentary

The Scholarship Chemistry assessment specifications emphasise that the examination is specifically designed to evaluate a broad understanding of the Chemistry curriculum. Candidates with a limited grasp of certain areas of the curriculum, often due to exposure to a narrow, selective range of achievement standards, are at a clear disadvantage. Candidates that demonstrated a breadth and depth of knowledge from across the curriculum were able to cope with unfamiliar and abstract situations and were suitably rewarded.

There were four questions in this year's examination, each addressing different key aspects of knowledge from the overall curriculum, which included:

- In Question 1, knowledge of acid-carbonate reactions, entropy changes in reactions, Lewis diagrams, molecular shapes and bond angles, acid-base titration curves, and buffering capacity of solutions.
- In Question 2, knowledge of chemical equilibria, complex ions, organic synthesis, major / minor organic products, IR spectroscopy, ^{13}C NMR spectroscopy, ionisation energy, bond enthalpies, ionic radii, and s,p,d electron arrangements.
- In Question 3, knowledge of quantitative analysis, quantitative calculations, titration procedures, accuracy and validity improving techniques, enthalpy calculations involving bond-enthalpies, enthalpies of reaction, and experimental data, reasons for variation in data-book enthalpy values, ester synthesis, hydrolysis, distillation and reflux.
- In Question 4, knowledge of solubility equilibria, solubility calculations, precipitation processes, oxidation-reduction processes, electrochemical cells, cell potential calculations, common observations for oxidation-reduction species, the radius of ions, the charge of ions, electrostatic attractions, and energy needs in processes.

Each question provided opportunities for candidates to demonstrate critical thinking, depth, insight, integration, detail, and accuracy. Candidates who did not answer significant portions of the exam often did not meet the Scholarship threshold. Candidates who were better prepared to complete mathematical calculations often yielded significantly better outcomes than those who were not, or left these questions blank or incomplete.

The quality of written communication is also considered. Candidates who provided unclear explanations, made significant calculation errors, or included irrelevant or incorrect chemistry principles, did not perform as highly as those who delivered well-crafted responses. Some candidates attempted to use advanced concepts from university-level reading to answer straightforward questions. These strategies often failed to address the simpler parts of questions, or provide the correct explanations, resulting in limited success. Such approaches are discouraged.

Common errors, omissions, or misconceptions that were observed included improper final rounding or missing units in calculation answers, incorrect or inaccurate terminology, unclear subject knowledge, the use of skeletal structures, missing atoms, reacting incorrect functional groups in organic schemes, or not using key terminology expected in questions. Many candidates were unable

to balance chemical equations, draw clear diagrams, discuss electrochemical cells, or make appropriate references in equilibrium discussions.

Report on performance standard

Candidates who were awarded Scholarship with **Outstanding Performance** commonly:

- completed the entire examination
- demonstrated a wide breadth of curriculum understanding
- communicated answers using correct units and significant figures
- communicated effectively using neat organic structures with expanded or condensed structural formulae (not skeletal)
- could justify the shape and polarity of an unfamiliar compound
- completed an acid-base titration curve clearly and justified the buffering capacity at different stages in the curve
- discussed the impact on the relative concentration of species, and observations, when changes were made to chemical equilibria
- understood methods for synthesising esters including conditions and safety risks
- wrote balanced equations from the descriptions given and linked the species in the equations to observations
- identified multiple elements from a description of atomic structure, and could justify why these elements were the correct choices and why other elements were not
- could give potential reasons for errors in titration processes
- could calculate enthalpy changes using bond enthalpy data, and discuss the accuracy of different methods for the same process
- could calculate concentrations using solubility data
- thoroughly understood electrochemical cells, and could justify oxidation-reduction changes occurring during electrochemical processes
- clearly discussed the relationship between protons in ions, the resulting radius and charge of ions, and the impact this had on the strength of electrostatic attractions between oppositely charged ions
- used all the information provided to answer the question, e.g. the teacher's value, reference to a fluorine ion
- consistently used correct chemistry conventions and appropriate significant figures.

Candidates who were awarded **Scholarship** commonly:

- completed a wide range of questions in the examination with very few left unanswered
- communicated using good chemistry vocabulary with clear handwriting
- discussed the formation of CO_2 in an acid-carbonate reaction, and addressed entropy changes to the system and surroundings during a chemical reaction
- drew neat Lewis diagrams and provided the correct shape names and bond angles for ions
- addressed changes in the concentration of reactants and products in chemical equilibrium, and related observations
- could calculate the main points for a titration curve, and plot them neatly
- could complete the organic reaction scheme with some correct products
- could write reasonable equations from the descriptions given
- understood the functioning of a buffer in relation to a titration curve, and could explain the functioning of a buffer in different situations

- explained the use of NMR and IR to differentiate between organic products, clearly and with specific peaks and units
- identified elements from a description of atomic structure, and could justify these choices clearly
- carried out quantitative calculations correctly to determine the concentrations of solutions provided experimental data
- understood validity in process and accuracy in the final answer for a titration
- could calculate enthalpy changes using experimental data and enthalpies of formation
- could describe two ways to form an ester clearly
- described reflux and distillation clearly with relevant detail
- completed solubility calculations to determine precipitation of species from mixtures
- discussed aspects of electrochemical cells correctly, such as oxidation-reduction processes, observations linked to species, the flow of charge, and movement of particles in solution
- addressed how the radius or charge of ions impacts on the strength of electrostatic attractions between oppositely charged ions.

Candidates who were **not awarded Scholarship** commonly:

- did not complete a number of questions in the paper
- did not apply Level 3 Chemistry understanding to unfamiliar contexts
- did not communicate using appropriate chemistry vocabulary
- did not manage their time well across the paper
- did not appear to have experience with New Zealand Scholarship-level questions
- provided rote-learned responses to questions which required a different approach
- were unable to draw correct Lewis diagrams, or provide correct shapes and bond angles
- had poor written communication – often wrote hard-to-read and -interpret sentences
- used generic language rather than specific
- did not show clear working for calculations
- could not recognise electrochemical cells or calculate a cell potential
- did not recognise reagents and conditions required for organic reactions
- could not discuss system, surroundings, or total entropy changes during reactions – for example incorrect thinking a solution cooling meant it was losing energy to the environment (exothermic)
- could not complete Lewis diagrams for ions
- could not complete titration curve calculations
- did not understand the impact of changes in concentration on chemical equilibrium
- did not correctly respond to the questions asked, e.g., completed incorrect calculations
- did not read the question carefully – when asked for a calculation or an equation, did not complete one
- could not explain how to synthesise an ester, or explain the equipment used during hydrolysis of an ester
- did not recognise simple Level 2 and 3 concepts such as HCl being present as dissociated ions (Cl^-) for the equilibrium question
- had difficulty writing equations from descriptions, which prevented them moving forward in the question
- had clear misconceptions relating to the atomic structure of elements
- could not perform simple quantitative calculations, often missing out mole ratios
- did not understand the process of carrying out a titration with respects to potential errors in the process

- could not calculate enthalpy changes using experimental data, Hess's law, or bond enthalpies
- used incorrect units or significant figures in calculations
- referred to concepts which incorrectly answered the question e.g. dipole attractions or entropy changes when referring to the energy required to break ionic bonds.