Assessment Report

New Zealand Scholarship Calculus 2022

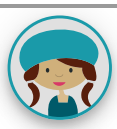
Standard 93202

Part A: Commentary

Candidates who were successful in this examination provided innovative and insightful solutions to problems. These candidates were in command of the foundational principles of algebra, trigonometry, and calculus. They could draw on this competence to approach questions holistically, integrating that knowledge rather than being reliant on a suite of single skill algorithms.

The assessment specifications for the Scholarship Calculus examination stress that the NZ Mathematics Curriculum is the material that is assessed, not the Achievement Standards. This immediately separated students who had covered most or all of the curriculum from those who had been exposed to, or cherry picked, a limited suite of Achievement Standards. More specifically:

- Many candidates did not complete the examination.
- Question One was the best performed question by most candidates, followed closely by Question Three. Candidates with a solid understanding of polynomials and differentiation rules did particularly well in Question One c and Question Three b.



- Question Four and Five required a solid understanding of algebra and calculus, along with experience and technique in problem solving. Competency in conic sections was essential as well as in the solution of differential equations.
- Candidates who were well prepared for this examination demonstrated flair and maturity in their solutions, which were efficient in the planning and execution.

As in previous examinations, knowledge areas and skills which were commonly demonstrated by successful students were:

- trigonometry – manipulation of identities and rational expressions
- foundational knowledge of polynomials – factors, roots, inequalities, and completing the square
- conic sections, in particular the relationship between the foci and the axes of an ellipse
- circle geometry.

Part B: Report on performance standard

Candidates who were awarded Scholarship with **Outstanding Performance** commonly demonstrated a high level of abstract thinking and a thorough understanding of the NZ Mathematics curriculum, rather than being confined to limited understanding of isolated standards.

They attempted most of the questions and could successfully solve at least two or three complete questions as well as answer more part questions correctly by applying multiple strands of the curriculum.

They showed clear communicational skills by setting out the problems logically. In specific, candidates commonly.

- demonstrated excellent ‘algebra’ manipulation skills in dealing with polynomials and complex expressions (Q1c, Q5a)
- showed a thorough understanding of the relationship between the roots and the coefficients of quadratics (Q2a)

- displayed ‘critical thinking’ skills in composing a mathematical model and optimising using calculus concepts when solving geometry question (Q2c, Q3c)
- could manipulate concisely and accurately ‘trigonometry identities/compound angles’ (Q2b, Q4b, Q4c)
- demonstrated understanding of the connection between trigonometric identities and complex numbers (Q4a)
- demonstrated skills in integrating trigonometric expression involving high powers (Q4b)
- showed in-depth understanding that an integral is an anti-derivative (Q5b)
- displayed ability in solving second order differential equation problems through substitution (Q5c).

Candidates who were awarded **Scholarship** commonly applied their knowledge and skills in complex problems and problems in unfamiliar context.

They showed good ‘algebra’ skills in solving equations / inequalities / complex numbers, giving exact valued answers.

They demonstrated sound ‘calculus’ skills that are given in unfamiliar context.

In particular, they:

- demonstrated a thorough understanding of ‘modulus of complex numbers’ (Q1a)
- showed ability in manipulating trigonometric identities accurately (Q1b, Q5a)
- showed good ‘algebra skills’ in manipulating expressions involving inequalities (Q2a)
- differentiated complex expressions involving exponential functions using the quotient rule (Q3a)
- constructed correct mathematical models and used them to find the related rates of change problems (Q3b)
- expanded high power expressions using the Binomial Expansion Formula (Q4a)
- showed understanding of the relationship between tangent and cotangent functions (Q5a).

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

- used a graphic calculator to get answers without showing necessary working
- abandoned / ‘fudged’ questions too early
- did not demonstrate the algebraic skills needed at this level
- did not differentiate composite functions
- demonstrated limited trigonometry knowledge and were did not use compound angle formulas appropriately
- did not find the general solutions of trig equations
- did not complete binomial expansions
- did not differentiate a function with 2 variables by changing it to 1 variable.

Subject page

Previous years' reports

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