NZQA
New Zealand Qualifications Authority
Mana Tohu Matauranga O Aotearoa

Assessment Report

New Zealand Scholarship
Calculus 2019

Standard 93202

Part A: Commentary

It was refreshing to see the number of candidates who provided innovative and insightful solutions to problems. These candidates had mastered the foundational principles of algebra, trigonometry and calculus and could draw on this competence to approach questions holistically, integrating that knowledge rather than being reliant on a suite of single skill algorithms.

There were, however, some candidates who failed to make any progress in solving even the easiest problem. They were not adequately prepared, particularly lacking algebraic and trigonometric skills needed at this level. A troubling number of candidates were awarded no marks at all.

Unsuccessful candidates were often let down by the poor layout of their solutions, not knowing when to abandon a strategy or failing to recognise how close they were to a solution and did not provide the final steps. However, the same can be said of good students not reaching the outstanding category of achievement. Careless notation and disorganised presentation resulted in good talent not being fully showcased.

Mention must be made about the Assessment Specifications. The Scholarship examination draws on the Mathematics Curriculum of New Zealand, not a subset of Achievement Standards. This was particularly evident in the very poor attempt made at question 2(d). While this is a challenging question, its solution lies on ratio and area. Technically, no more than Level 1 knowledge is required to solve the problem. However, when students have a very granular view of the mathematics curriculum, it becomes extremely challenging. At scholarship level, knowing how to differentiate and integrate a polynomial is not sufficient. Implicit differentiation and integration using substitution (the so-called reverse chain rule) are essential skills.

In closing, tribute must be paid to those candidates who earned outstanding scholarships. They displayed a mastery of mathematics, flair and creativity in their solutions. Overall, those candidates worthy of scholarship and outstanding scholarship were made clearly visible by this examination paper.

Part B: Report on performance standard

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

- produced clear and logical working
- demonstrated elegance and flair when manipulating algebraic and trigonometric expressions
- planned their strategies and executed the plan
- understood when to preserve and when to abandon an approach
- use implicit differentiation to find the derivative of arctan
- applied mathematical knowledge in unfamiliar context
- established an equation and differentiated it to find an optimal solution
- determined whether an optimised solution was a minimum or maximum
- solved a first order differential equation by separating variables
- demonstrated understanding of the 1-1 relationship between and over the appropriate domain.

Candidates who were awarded **Scholarship** commonly:

- established and differentiated an equation to find an optimal solution

- rationalised the denominator of a complex number
- considered the relevance of a domain restriction when solving problems
- checked the validity of solutions
- understood the ramifications of a quadratic discriminant on the nature of the solutions
- analysed and manipulated expressions with absolute value symbols and inequalities
- integrated functions using the reverse-chain rule or a simple substitution
- solved non-linear systems of equations using substitutions
- differentiated a function using first principles
- analysed correctly the narrative of a related rate of change problem
- applied a conjugate to simplify an expression involving complex numbers
- understood the mathematical notion of generalised proof
- applied trigonometric identities and formulae to demonstrate proof.

Other candidates

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

- made careless algebraic errors
- did not check the validity of their solutions
- lacked consistency in algebra manipulations
- abandoned their efforts too quickly
- attempted to “fudge” proofs rather than find algebraic errors in their working
- provided calculator only solutions where algebraic working was clearly expected
- did not know that absolute value symbols are algebraic operators
- did not know the basic log rules
- displayed serious algebraic misconceptions such as:
    - If $(x – 2)^2 > 0$, *then $x > 2$ is the only solution*.
    - If $a^2 – b^2 = c^2$, *then $a – b = c$*
    - If $xy < 0$, *then $x < 0$ and $y < 0$*
- could not use substitution or the reverse chain rule to find an antiderivative
- could not differentiate using first principles or work with limit notation
- were unfamiliar with Leibniz notation for derivatives,
- did not understand the significance of the differentials in the Leibniz notation
- could not form an equation using one variable.

Subject page

Previous years' reports (PDF, 189KB)

2018 (PDF, 101KB)

2017 (PDF, 40KB)

2016 (PDF, 189KB)
