Assessment Report

New Zealand Scholarship Calculus 2024

Performance standard 93202

General commentary

This year's examination contained enough accessible problems for candidates to demonstrate their mathematical ability, and candidates working at Scholarship level clearly stood out. The paper consisted of a balanced distribution of topics that allowed candidates to demonstrate flexibility to approach problems from multiple perspectives, fostering diverse problem-solving methods.

The format of the examination (four questions with multiple sub-parts) remained consistent from the year prior, so this familiarity appeared to aid students in using their time efficiently across the whole paper. It was pleasing to see a high proportion of students making valiant attempts to solve problems unfamiliar to them, and, as always, it was heartening to see the insight shown by our top students, particularly those working at the Outstanding level. The move to a write-on answer booklet this year allowed candidates to organise their responses better, and whilst the allocated space was intended as an indicator of the amount of work required to solve the problem, many students found the need to utilise the extra space at the back to finish their responses.

All questions appear to have been of similar difficulty to candidates, with each containing at least one more challenging subpart, and generating a similar spread in performance. Students proficient in algebra, trigonometry, coordinate geometry, and conic sections were more likely to persevere with and succeed in these harder questions, and generally achieved higher marks overall. As mentioned in previous examination reports, it is important to stress that Scholarship candidates need to be exposed to a wide range of mathematics, spanning the entire Level 8 curriculum.

Report on performance standard

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

- showed insight, flair, and perseverance in their solutions
- demonstrated consistency in tackling proof-style questions by following through each step through to completion of the task
- showed proficiency in manipulating trigonometric identities throughout the examination
- considered special cases for problems such as $\alpha = 0$ in Question One1 (b)
- were able to formed and optimised an expression as was required in Question One 1(c)
- demonstrated a comprehensive grasp of the absolute value function by adeptly expressing the summation of the series in Question Two 2 (c), often making use of symmetry in their response
- chose appropriate limits of integration in Question Three 3 (b) that ensured the resulting distance was not zero
- used the hint in Question Three 3 (c) to identify the geometric sequences and series present, along with the correct parameters
- displayed strong coordinate geometry skills in setting up the locus equation in Question Four (c), along with the implicit differentiation skills needed to find the required rate.

Candidates who were awarded **Scholarship** commonly:

- differentiated the rational function in Question One (a) using the quotient rule, and determined the nature of the turning points using the graph or equation provided
- found a simple limit of the rational function in Question One (a), and connected this with the horizontal asymptote of the function
- applied the discriminant to the resulting quadratic equation in Question One (b) to determine when the system had no solution
- used the second derivative of the function in Question One (c) to find the steepest gradient, and connect this to the "gradient" of the steps to be built
- worked with unfamiliar functions such as those introduced in Question Two (a) and Question Two (c)
- showed excellent ability to implicitly differentiate the differential equation in Question Two (b)
- displayed fluency in applying trigonometric identities to simplify the integrands in Question Three (a) and Question Three (b) to expressions with known anti-derivatives
- demonstrated a thorough understanding of loci to sketch the required region in the Argand diagram for Question Four (a), and in the conics-based questions posed in Question Four (c), proved results using well-structured logical reasoning.

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

- did not attempt many questions, or abandoned responses too early
- persevered with long-winded approaches when no real progress was being made
- did not answer the question posed
- showed basic algebraic errors and struggled with the manipulation of trigonometric identities which prevented further progress
- relied on their graphical calculators to "solve" problems rather than applying the calculus skills being tested
- did not determine the nature of stationary points
- did not find the limit of a function as x approaches infinity, nor understand how a function could intersect with one of its asymptotes (many thought this was not possible)
- made equations equal to zero for no particular reason, such as in Question Three (b) where candidates seemed to set out to find the stationary points on the curve rather than the coordinates closest to the origin.