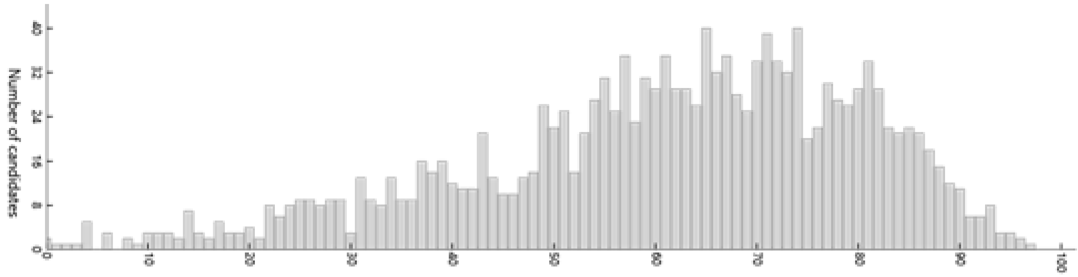
Government of **Western Australia**
School Curriculum and Standards Authority

Summary report of the 2021 ATAR course examination report:
Mathematics Specialist

Year	Number who sat	Number of absentees
2021	1503	18
2020	1526	23
2019	1435	32
2018	1546	21

The number of candidates sitting and the number attempting each section of the examination can differ as a result of non-attempts across sections of the examination.

Examination score distribution–Written



Summary
The examination consisted of Section One: Calculator-free and Section Two: Calculator-assumed.

Attempted by 1501 candidates	Mean 60.77%	Max 96.82%	Min 0.00%

Section means were:			
Section One: Calculator-free	Mean 64.63%		
Attempted by 1501 candidates	Mean 22.62(/35)	Max 35.00	Min 0.00
Section Two: Calculator-assumed	Mean 58.68%		
Attempted by 1499 candidates	Mean 38.14(/65)	Max 62.53	Min 0.00

General comments
The 2021 paper gave candidates ample opportunity to demonstrate their ability, as indicated by a mean of 60.77%, in comparison to the 2020 mean of 57.74%. The mean of the Calculator-free section was 64.64%, which contrasted with the Calculator-assumed mean of 58.68%.

There were many standard syllabus questions and correspondingly candidates performed very well: sketching an inverse function (Question 2 part (a)), sketching a rational function (Question 4), integration by substitution (Questions 3 and 8 part (c)), separation of variables (Question 10 part (b)), use of partial fractions (Question 5) and implicit differentiation (Question 18 part (a)).

The paper also contained many questions that examined candidates' conceptual understanding and command of detail. These types of questions proved challenging for many and indicated a less than adequate grasp of the syllabus. This was seen principally in the work in solving a quartic equation in the complex plane (Question 6), the intersection of planes (Question 14) and vectors in three dimensions (Question 16). Candidates' ability to write coherent and meaningful explanations in explaining or justifying mathematics requires further emphasis and practice.

The non-routine questions in this paper permitted the most capable candidates to shine, as indicated by a good number of candidates who scored in excess of 80%.

The distribution of marks, as in 2020, exhibited a large spread, indicated by the standard deviation of 19.28%.

Whilst the paper contained fewer total questions than in 2020, the length of the paper was not considered to be shorter than in previous years. It appeared that most candidates had an opportunity to attempt what they could. The last question (Question 19) had a large number of candidates attempting it, with only a small drop off with the last part (Question 19 part (e)).

Advice for candidates

- Ensure that working is copied correctly from line to line. For example, ensure a negative number does not become positive in the next line.
- Ensure your work or calculations have an obvious sequence or conclusion, enabling the marker to follow your line of thought and to observe a conclusion. Markers cannot be expected to extract meaning from a collection of numbers on the page without any clear conclusion or statement.
- Do not use the word ‘it’ in explanations. For example, if asked why the inverse of g is not a function, markers do not know what a candidate means when they write ‘it is many to one’. You need to be specific in your responses.
- Ensure that the correct units are used in giving answers, particularly in questions asking for a rate of change. Careful reading of the question is central to this.
- Improve the legibility of digits.
- Take care when reading the scale of a graph.
- Use the exact value from the calculator and hence do not truncate decimal places early in a question.

Advice for teachers

- Provide opportunities for students to prove mathematics results. For example, in Question 16 part (c), many candidates thought it was sufficient to report that the CAS calculator said that there was ‘no solution’, without proving the results.
- Improve the conceptual understanding of the intersection of planes in space, particularly when there is not a unique solution.
- Emphasise the use of correct mathematics vocabulary and provide students with opportunities to explain mathematics concepts.
- Improve students’ command of general algebraic tasks. For example, markers witnessed an inability to correctly expand brackets (Question 6 part (a)) or incorrectly assuming distributive laws like $\sqrt{2-\sin^2\theta} = \sqrt{2} - \sin\theta$ (Question 8 part (c)).
- Improve students’ knowledge and use of exact trigonometric values.

Comments on specific sections and questions

Section One: Calculator-free (49 Marks)
Candidates performed very well in the Calculator-free section (mean of 64.63%), particularly in working with an inverse function, sketching a rational function and with techniques of integration. There were some excellent efforts in Question 7 part (b) to justify why the separate complex equations had only one common solution.

Weaknesses in routine skills evident in this section were:

- determining the argument for the opposite of a complex number (Question 1 part (a))
- performing manual arithmetic or recalling exact trigonometric values (Question 1 part (b))
- correctly multiplying two complex factors $(z-(2+4i))(z-(2-4i)) = (z^2-4z+20)$ (Question 6 part (a))
- solving $z^2-2z+3=0$. It was not expected that candidates would suggest solving $(z-3)(z+1)=0$ (Question 6 part (b)).

Section Two: Calculator-assumed (92 Marks)
Performance on the Calculator-assumed section was adequate with a mean of 58.68%, but not as good as the Calculator-free section. This was due to the wider array of concepts being examined, requiring a full understanding of the course. Able candidates were able to demonstrate their sound conceptual grasp.

Weaknesses in routine skills evident in this section were:

- recognising that a set of linear equations has an infinite number of solutions (Question 14 part (c))
- describing the geometric significance of the given equations and solution (Question 14 part (d))
- determining the vector equation of a line or Cartesian equation of a sphere (Question 16 parts (a) and (b))
- proving that two lines in space do not intersect. Stating that a CAS calculator says there is no solution does not constitute a proof (Question 16 part (c)).