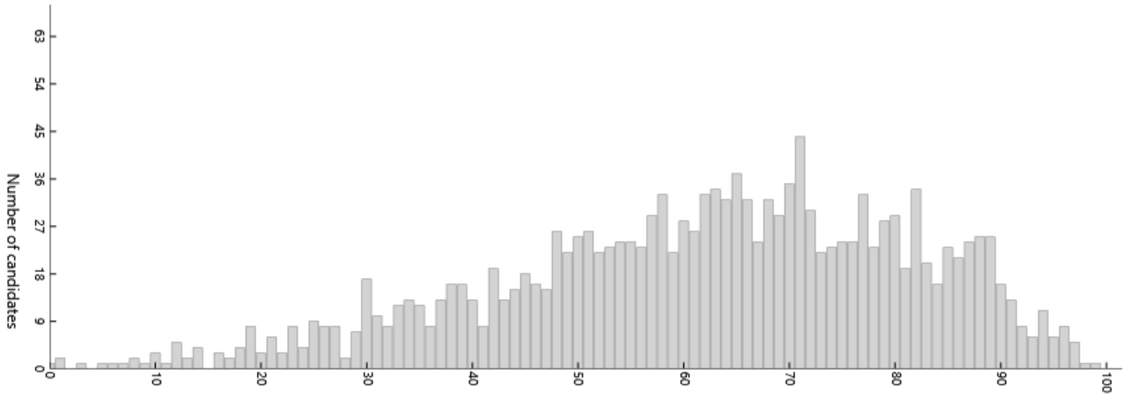
Government of **Western Australia**
School Curriculum and Standards Authority

Summary report of the 2018 ATAR course examination:
Mathematics Specialist

Year	Number who sat	Number of absentees
2018	1546	21
2017	1463	12
2016	1427	17

Examination score distribution–Written



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

Attempted by 1546 candidates	Mean 61.73%	Max 99.29%	Min 0.00%
Section means were:			
Section One: Calculator-free	Mean 63.68%		
	Mean 22.29(/35)	Max 35.00	Min 0.00
Section Two: Calculator-assumed	Mean 60.78%		
	Mean 39.51(/65)	Max 64.29	Min 0.00

General comments
The paper was well received, with a common theme in the feedback being that the paper was of an appropriate standard for the Mathematics Specialist cohort. The paper contained a range of questions allowing the typical candidate to show facility with key standard concepts, yet containing elements in each question to discriminate amongst candidates.

The length of the paper was deemed to be appropriate, as evidenced by 96% of candidates attempting Question 20 part (a), as compared to 92% attempting Question 19 part (a).

As with 2017, there was no single question that was highlighted as the 'challenge' question, but there were many questions requiring conceptual understanding beyond the standard text type questions.

The distribution of marks in 2018 exhibited a relatively high spread, indicated by the standard deviation of 19.46% compared to the 2017 figure of 17.40% (despite the comparable means of 61.73% and 63.95%). This year there appeared to be a significant number of candidates who were not able to answer many straightforward questions or offer any response to questions.

Many markers reported that it was very pleasing to see a good number of able candidates showing elegant and original solutions to some of the more conceptually demanding questions. This was evident particularly for Question 3 part (c), where a couple of candidates displayed a solution purely with the use of trigonometric identities. Question 11 part (b), Question 17 part (c), Question 19 part (c) and Question 20 part (c) were some notable others where different mathematics ideas were displayed to that in the solutions and marking key. In these cases, the correct use of alternative mathematics was amply rewarded.

However, a striking feature was that many candidates (even those scoring in the 70-80% range), demonstrated a disturbing lack of facility expected of Mathematics Specialist candidates in the performance of algebraic processes and the appropriate use of brackets. This was particularly noticeable in the following questions:

- Question 2 part (a) – solving simultaneous linear equations by algebraic means
- Question 3 part (a) – determining the real part of a complex number
- Question 9 part (a) – simplifying an expression requiring the squaring of a binomial term
- Question10 – showing a result that required the use of brackets
- Question 20 parts (a) and (b) – differentiating/evaluating an expression that required the appropriate use of brackets.

For Question 9(a), the ability to expand an expression such as $\left(\sqrt{3}\tan u+1\right)^2$ proved problematic. At least 30.5% of the cohort did not perform this task correctly. Given that 30.5% of the cohort scored zero out of two for this task, it is estimated that this actual number could have been as high as 38%, since 20.8% scored one mark out of two. Those who scored one mark often failed to expand correctly but then scored the mark by correctly applying the identity $\sec^2 u = 1+\tan^2 u$ to an incorrect expansion. In viewing and reconciling scripts, it is estimated that approximately a third of those who scored one mark out of two could not expand correctly.

Advice for candidates

- Write legibly so that markers can discern the digits and ideas in a solution.
- Show the relevant mathematics that was used if a CAS solution is employed, e.g. indicate the mathematical equation that is being solved and refrain from writing calculator-speak type statements.
- In questions requiring explanation or reasoning, refrain from using the word ’it’ as usually it is not clear what concept is being referred to, e.g. ‘it’ is normally distributed. Be specific.
- Understand the correct use of brackets.
- Use mathematics notation correctly.
- Provide working for all questions worth two or more marks.

Advice for teachers

- Continue to provide opportunities for students to explain aspects of the course.
- Stress the importance of using brackets appropriately to assist students in simplifying expressions.
- Provide opportunities to display conceptual knowledge of concepts often required outside of typical text type questions.
- Improve the mathematics notation used by candidates, specifically in the vectors section of the course. In the 2018 paper, there were no marks allocated for the correct use of notation.

Comments on specific sections and questions

Section One: Calculator-free (35 Marks)

In the calculator-free section the following areas were handled well:

- domain for the function composition $g\left(f\left(x\right)\right)$ in Question 1 (b)
- simultaneous solution of linear equations in Question 2 (a)
- using DeMoivre's theorem in Question 3 (b) for complex numbers
- identifying functions constants from the graph of a rational function in Question 4
- evaluation of the definite integral using a trigonometric substitution in Question 5.

Candidates performed relatively poorly in the following areas:

- explaining whether a system of equations will have a unique solution or not and stating the geometric significance in Question 2 (b)
- using the vector interpretation for a complex number in Question 3 (b) (ii)
- solving a relatively simple complex equation in Question 7 (a)
- explaining how $\underset{\sim}{c}.\left(\underset{\sim}{a}\times\underset{\sim}{b}\right)$ will give the volume of a parallelopiped in Question 8 (b)
- algebraic expansion of a binomial involving a trigonometric expression in Question 9 (a).

Section Two: Calculator-assumed (65 Marks)

In the calculator-assumed section the following areas were handled well:

- recognition of the locus of a complex number in Question 11 (a)
- understanding of the distribution of the sample mean being normal in Question 12 (a)
- sketching the graph of the function $y=\dfrac{1}{f\left(x\right)}$ in Question 14 (a)
- determining the area trapped between a curve and a line and the resultant volume in Question 15
- implicit differentiation in Question 20 (a).

Candidates performed relatively poorly in the following areas:

- determining the acceleration of a particle where $v=f\left(x\right)$ in Question 13 (a)
- rejecting the notion that we can know with certainty which confidence interval will contain an unknown population mean in Question 16 (d)
- determining the equation of a sphere given that a plane is a tangent to the sphere in Question 17 (c)
- deriving the vector expression for $\underset{\sim}{r}\left(t\right)$ from the acceleration vector for a projectile. Far too many candidates could not fluently and convincingly show how the integration constants were used to develop $\underset{\sim}{r}\left(t\right)$ in Question 19 (a)
- determining the cartesian equation from the vector equation in Question 19 (b) was also poorly done.