YEAR 12 STARTER KIT | 2027

Specialist Mathematics

Proof, complex numbers, vectors, and advanced calculus

SACE Stage 2 | South Australia

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Stage 2 Specialist Mathematics is designed for students with a strong mathematical background who are aiming for STEM degrees. It extends Mathematical Methods with proof, complex numbers, 3D vectors, and differential equations.

Welcome to Stage 2 Specialist Mathematics

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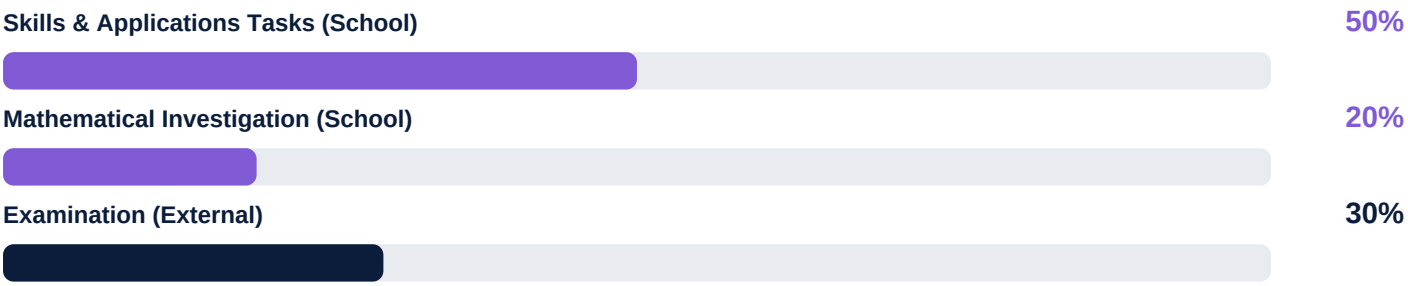
What You Should Know from Stage 1

Before diving into Stage 2 Specialist Mathematics, make sure you're confident with these Stage 1 foundations. If any feel shaky, revise them in the holidays — it'll make your Year 12 start so much smoother.

- [x] Stage 2 Mathematical Methods (co-requisite)
- [x] Proof and logical reasoning
- [x] Trigonometric identities
- [x] Vectors in 2D
- [x] Polynomial division and factor theorem

How You'll Be Assessed

Stage 2 Specialist Mathematics is assessed through school assessment (70%) and external assessment (30%). Here's the breakdown:



Topics You'll Cover

Stage 2 Specialist Mathematics is organised into 6 main topics. Each topic builds on the last, so staying on top of the content week by week is crucial.

1 Mathematical Induction

- Proof by mathematical induction (divisibility, sums, inequalities)

2 Complex Numbers

- Cartesian and polar forms
- The complex (Argand) plane
- Roots of complex numbers (De Moivre's theorem)
- Factorisation of polynomials over C

3 Functions and Sketching Graphs

- Composition of functions
- One-to-one functions and inverses
- Sketching graphs (rational functions, absolute value)

4 Vectors in Three Dimensions

- Algebra of vectors in 3D (dot and cross product)
- Vector and Cartesian equations of lines and planes
- Systems of linear equations

5 Integration Techniques and Applications

- Integration by substitution and by parts
- Partial fractions
- Applications: volumes of revolution, arc length

6 Rates of Change and Differential Equations

- Implicit differentiation
- Differential equations (separable, slope fields)
- Parametric equations (polynomial and trig)
- Related rates and velocity vectors

Key Formulas and Concepts

These are some of the most important formulas and concepts you'll use throughout the year. Bookmark this page — you'll come back to it often.

z = r(cos(theta) + i sin(theta)) = r cis(theta)

Polar form of a complex number

z^n = r^n cis(n theta)

De Moivre's theorem

a . b = |a||b| cos(theta)

Dot product of vectors

a x b = |a||b| sin(theta) n-hat

Cross product of vectors

integral u dv = uv - integral v du

Integration by parts

dy/dx = f(x) g(y) => integral dy/g(y) = integral f(x) dx

Separable differential equations

Insider Tips from Our Tutors

! Induction Has a Template

Every induction proof follows: (1) prove base case, (2) assume true for k, (3) prove for k+1 using the assumption. The "trick" is always in step 3 — practice algebraic manipulation to bridge the gap.

! Complex Numbers Are Beautiful

Once you see complex numbers on the Argand plane, multiplication becomes rotation and scaling. Polar form makes powers and roots elegant. Draw diagrams for every question.

! Specialist Builds on Methods

You must be strong in Methods content (especially calculus) before tackling Specialist. The integration techniques here assume you've already mastered basic integration.

Common Mistakes to Avoid

Our tutors have seen these mistakes cost students marks year after year. Learn from others' errors so you don't repeat them.

X Incomplete induction proofs

Students often skip clearly stating the inductive hypothesis or fail to show exactly where they use the k assumption in the k+1 step. The marker checks for these explicitly.

X Polar vs Cartesian form errors

When converting between forms, watch the quadrant of the argument. atan(y/x) gives the wrong angle in Q2 and Q3 — you must adjust.

X Vectors: forgetting direction of cross product

The cross product is NOT commutative: a x b = -(b x a). Use the right-hand rule to determine direction, and always check your sign.

Your Year 12 Study Timeline

A term-by-term plan to stay on top of Stage 2 Specialist Mathematics. Adapt this to your school's order of topics, but keep the revision schedule tight.

Term 1 (Weeks 1-10)

- Master mathematical induction (Topic 1)
- Complete complex numbers (Topic 2)
- Start functions and graph sketching (Topic 3)

Term 2 (Weeks 1-10)

- Complete 3D vectors (Topic 4) — this is substantial
- Submit mathematical investigation draft
- Keep your Methods skills sharp alongside Specialist

Term 3 (Weeks 1-10)

- Complete integration techniques (Topic 5) and DEs (Topic 6)
- Finalise all school assessment tasks
- Begin past paper practice — weekly timed sessions

Term 4 / Exam Prep

- Do 5+ full past exams under timed conditions
- Review formula sheet — especially integration formulas and vector identities
- Weak areas for most students: DEs, parametric equations, volumes of revolution

Exam Day Strategies

When exam day arrives, these strategies will help you maximise your marks. Print this page and stick it on your wall in the weeks leading up.

Strategy 1

Induction proofs almost always appear. Drill the template until it is automatic: base case, assume k, prove k+1.

Strategy 2

For complex number questions, sketch the Argand diagram. Most geometric questions become obvious when drawn.

Strategy 3

In vector questions, state whether you are using dot product (scalar result) or cross product (vector result).

Strategy 4

This is the hardest SACE maths subject. If you run out of time, show the setup even if you cannot finish — partial marks are available.

Ready to Ace Specialist Mathematics?

- All tutors are med students with 99+ ATARs
- Small group classes & 1-on-1 tutoring available
- Aligned to the SACE Stage 2 curriculum
- Weekly classes with exam-focused practice
- Flexible weekly plans — cancel anytime

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