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

Sample Course Outline

Mathematics Specialist

ATAR Year 11

Acknowledgement of Country

Kaya. The School Curriculum and Standards Authority (the Authority) acknowledges that our offices are on Whadjuk Noongar boodjar and that we deliver our services on the country of many traditional custodians and language groups throughout Western Australia. The Authority acknowledges the traditional custodians throughout Western Australia and their continuing connection to land, waters and community. We offer our respect to Elders past and present.

Sample course outline

Mathematics Specialist – ATAR Year 11

Unit 1

In Unit 1 students will be provided with opportunities to:

- understand the concepts and techniques in combinatorics, geometry and vectors
- apply reasoning skills and solve problems in combinatorics, geometry and vectors
- communicate their arguments and strategies when solving problems
- construct proofs in a variety of contexts, including algebraic and geometric
- interpret mathematical information and ascertain the reasonableness of their solutions to problems.

This course outline assumes an allocation of 4 hours contact time per week for the course.

Each semester is based on a 15 week block.

Week	Syllabus content
1	**Geometry (1.1.1–1.1.15)** The nature of proof – use implication, converse, equivalence, negation, inverse, contrapositive, proof by contradiction, counter-examples and associated symbols and quantifiers
2–4	Circle properties, including proof and use – solve problems determining unknown angles and lengths and prove further results using circle properties and suitable converses
5	**Combinatorics (1.2.1–1.2.9)** Permutations (ordered arrangements) – solve problems involving permutations, use factorial notation, multiplication and addition principle
6	The inclusion-exclusion principle for the union of two sets, the pigeon-hole principle – determine and use the formulas for finding the number of elements in the union of two and the union of three sets, solve problems and prove results using the pigeon-hole principle
7	Combinations (unordered selections) – solve problems involving combinations, derive and use associated simple identities associated with Pascal's triangle
8–9	**Vectors in the plane (1.3.1–1.3.14)** Representing vectors in the plane by directed line segments – examine examples of vectors, define and use magnitude and direction, represent a scalar multiple of a vector and use the triangle and parallelogram rules to find the sum and difference of two vectors
10–12	Algebra of vectors in the plane – use ordered pair notation and component form, define unit vectors, use addition and subtraction in component form and multiplication by a scalar, use and apply scalar product, examine properties of parallel and perpendicular vectors, define and use projection of vectors and solve problems involving displacement, force and velocity
13–14	**Geometry (1.3.15–1.3.17)** Geometric vectors in the plane, including proof and use – use vectors to establish and prove properties of parallelograms
15	Semester 1 examination

Unit 2

In Unit 2 students will be provided with opportunities to:

- understand the concepts and techniques in trigonometry, real and complex numbers, and matrices
- apply reasoning skills and solve problems in trigonometry, real and complex numbers, and matrices
- communicate their arguments and strategies when solving problems
- construct proofs of results
- interpret mathematical information and ascertain the reasonableness of their solutions to problems.

This course outline assumes an allocation of 4 hours contact time per week for the course.

Each semester is based on a 15 week block.

Week	Syllabus content
1	**Trigonometry (2.1.1–2.1.9)** The basic trigonometric functions – determine solutions of $f(a(x-b))=c$ and graph functions of the form $y=f(a(x-b))+c$ where f is one of sine, cosine or tangent
2–3	Compound angles and trigonometric identities – prove and apply the angle sum, difference, double angle, Pythagorean and products of sines and cosines expressed as sums and differences and other trigonometric identities, convert sums $a \cos x + b \sin x$ to $R \cos(x \pm \alpha)$ or $R \sin(x \pm \alpha)$ and apply these to sketch graphs; solve equations of the form $a \cos x + b \sin x = c$
4	Define and sketch graphs of the reciprocal trigonometric function and simple transformations of them, applications of sine and cosine functions to model periodic phenomena
5–6	**Matrices (2.2.1–2.2.11)** Matrix arithmetic – apply matrix definition and notation, define and use addition, subtraction, scalar multiplication, matrix multiplication, multiplicative identity and inverse, calculate the determinant and inverse of 2 × 2 matrices and solve matrix equations of the form AX = B, where A is a 2 × 2 matrix and X and B are column vectors
7–8	Transformations in the plane – examine translations and their representation as column vectors, define and use basic linear transformations: dilations of the form $(x,y) \longrightarrow (\lambda_1 x, \lambda_2 y)$, rotations about the origin and reflection in a line that passes through the origin and the representations of these transformations by 2 × 2 matrices, apply these transformations to points in the plane and geometric objects, define and use composition and inverses of linear transformations and the corresponding matrix products and inverses, examine the relationship between the determinant and the effect of a linear transformation on area, establish geometric results by matrix multiplications
9	Systems of linear equations – interpret the matrix form of a system of linear equations in two variables and use matrix algebra to solve a system of linear equations
10–11	**Real and complex numbers (2.3.1–2.3.16)** Proofs involving numbers, rational and irrational numbers – prove simple results involving numbers, express rational numbers as terminating or eventually recurring decimals and vice versa and prove irrationality by contradiction for numbers such as $\sqrt{2}$
12	An introduction to proof by mathematical induction – develop the nature of inductive proof, including the 'initial statement' and inductive step, prove results for sums, such as $1+4+9...+n^2=\frac{n(n+1)(2n+1)}{6}$ and prove divisibility results, such as $3^{2n+4}-3^{2n}$ is divisible by 5 for any positive integer n

Week	Syllabus content
13	Complex numbers and the complex plane – define the imaginary number *i* as a root of the equation $x^2 = -1$, represent complex numbers in the rectangular form; *a* + *bi* where *a* and *b* are the real and imaginary parts, and consider complex numbers as Cartesian coordinates in the complex plane; determine and use complex conjugates and perform complex number arithmetic
14	Roots of equations – use the general solution of real quadratic equations, determine complex conjugate solutions and linear factors of real quadratic polynomials
15	**Semester 2 examination**