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

SAMPLE COURSE OUTLINE

MATHEMATICS METHODS
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 ourrespect to Elders past and present.

Disclaimer

Any resources such as texts, websites and so on that may be referred to in this document are provided as examples of resources that teachers can use to support their learning programs. Their inclusion does not imply that they are mandatory or that they are the only resources relevant to the course.

Sample course outline

Mathematics Methods – ATAR Year 11

Unit 1

Time placement (and allocation)	Topic/s	Key teaching points – Syllabus reference/s
Week 1 (4 hours)	Topic 1.1: Counting and probability	**Combinations** (1.1.1 – 1.1.3) • understand the notion of a combination as a set of r objects taken from a set of n distinct objects • use the notation $\binom{n}{r}$ and the formula $\binom{n}{r}=\frac{n!}{r!(n-r)!}$ for the number of combinations of r objects taken from a set of n distinct objects • investigate Pascal's triangle and its properties to link $\binom{n}{r}$ to the binomial coefficients of the expansion of $(x+y)^n$ for small positive integers n
Week 2 (4 hours)	Topic 1.1: Counting and probability	**Language of events and sets** (1.1.4 – 1.1.6) • review the concepts and language of outcomes, sample spaces, and events, as sets of outcomes • use set language and notation for events, including: a. $\overline{A}$ (or A') for the complement of an event A b. $A\cap B$ and $A\cup B$ for the intersection and union of events A and B respectively c. $A \cap B \cap C$ and $A \cup B \cup C$ for the intersection and union of the three events A, B and C respectively d. recognise mutually exclusive events • use everyday occurrences to illustrate set descriptions and representations of events and set operations
Week 3 (4 hours)	Topic 1.1: Counting and probability	**Review of the fundamentals of probability** (1.1.7 – 1.1.10) • review probability as a measure of 'the likelihood of occurrence' of an event • review the probability scale: $0 \le P(A) \le 1$ for each event, A with $P(A)=0$ if A is an impossibility and $P(A)=1$ if A is a certainty • review the rules: $P(\overline{A})=1-P(A)$ and $P(A\cup B)=P(A)+P(B)-P(A\cap B)$ • use relative frequencies from data as estimates of probabilities

Time placement (and allocation)	Topic/s	Key teaching points – Syllabus reference/s
Weeks 4 (4 hours)	Topic 1.1: Counting and probability	**Conditional probability and independence** (1.1.11 – 1.1.15) • understand the notion of a conditional probability and recognise and use language that indicates conditionality • use the notation $P(A\|B)$ and the formula $P(A \cap B) = P(A\|B)P(B)$ • understand the notion of independence of an event A from an event B, as defined by $P(A\|B) = P(A)$ • establish and use the formula $P(A \cap B) = P(A)P(B)$ for independent events A and B, and recognise the symmetry of independence • use relative frequencies obtained from data as estimates of conditional probabilities and as indications of possible independence of events
Week 5 (2 hours)	Topic 1.2: Functions and graphs	**Lines and linear relationships** (1.2.1 – 1.2.2) • recognise features of the graph of $y = mx + c$, including its linear nature, its intercepts and its slope or gradient • determine the equation of a straight line given sufficient information, including parallel and perpendicular lines
Weeks 5–6 (6 hours)	Topic 1:2 Functions and graphs	**Quadratic relationships** (1.2.3 – 1.2.8) • examine examples of quadratically related variables • features of the graphs of $y = x^2$, $y = a(x - b)^2 + c$, and $y = a(x - b)(x - c)$, including their parabolic nature, turning points, axes of symmetry and intercepts • solve quadratic equations, including the use of quadratic formula and completing the square • determine the equation of a quadratic given sufficient information • determine turning points and zeros of quadratics and understand the role of the discriminant • recognise features of the graph of the general quadratic $y = ax^2 + bx + c$

Time placement (and allocation)	Topic/s	Key teaching points – Syllabus reference/s
Weeks 7–8 (8 hours)	Topic 1.2: Functions and graphs	**Inverse proportion** (1.2.9 – 1.2.10) • examples of inverse proportion • recognise features and determine equations of the graphs of $y = \frac{1}{x}$ and $y = \frac{a}{x-b}$, including their hyperbolic shapes and their asymptotes **Powers and polynomials** (1.2.11 – 1.2.16) • graphs of $y = x^n$ for $n \in \boldsymbol{N}, n = -1$ and $n = ½$, shape, behaviour as $x \to \infty$ and $x \to -\infty$ • identify the coefficients and the degree of a polynomial • expand quadratic and cubic polynomials from factors • recognise features and equations of the graphs of $y = x^3$, $y = a(x-b)^3 + c$ and $y = k(x-a)(x-b)(x-c)$; including shape, intercepts and behaviour as $x \to \infty$ and $x \to -\infty$ • factorise cubic polynomials (in cases where a linear factor is easily obtained) • solve cubic equations using technology, and algebraically in cases where a linear factor is easily obtained
• Weeks 9–10 • (8 hours)	Topic 1.2: Functions and graphs	**Graphs and relations** (1.2.17 – 1.2.18) • recognise features and equations of the graphs of $x^2 + y^2 = r^2$ and $(x-a)^2 + (y-b)^2 = r^2$, including their circular shapes, centres and radii • recognise features of the graph of $y^2 = x$, including its parabolic shape and axis of symmetry **Functions** (1.2.19 – 1.2.24) • understand the concept of a function as a mapping between sets and as a rule or a formula that defines one variable quantity in terms of another • use function notation; determine domain and range; recognise independent and dependent variables • understand the concept of the graph of a function • examine translations and the graphs of $y = f(x) + a$ and $y = f(x-b)$ • examine dilations and the graphs of $y = cf(x)$ and $y = f(dx)$ • recognise the distinction between functions and relations and the vertical line test

Time placement (and allocation)	Topic/s	Key teaching points – Syllabus reference/s
Weeks 11–12 (7 hours)	Topic 1.3: Trigonometric functions	**Cosine and sine rules** (1.3.1 – 1.3.4) • review sine, cosine and tangent as ratios of side lengths in right-angled triangles • understand the unit circle definition of $\cos\theta$, $\sin\theta$ and $\tan\theta$ and periodicity using degrees • examine the relationship between the angle of inclination of a line and the gradient of that line • establish and use the cosine and sine rules, including consideration of the ambiguous case and the formula $Area = \frac{1}{2}bc\ sin\ A$ for the area of a triangle **Circular measure and radian measure** (1.3.5 – 1.3.6) • define and use radian measure and understand its relationship with degree measure • use radian measure to calculate lengths of arcs and areas of sectors and segments in a circle
Weeks 13–14 (8 hours)	Topic 1.3: Trigonometric functions	**Trigonometric functions** (1.3.7 – 1.3.16) • understand the unit circle definition of $\sin\theta$, $\cos\theta$ and $\tan\theta$ and periodicity using radians • recognise the exact values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ at integer multiples of $\frac{\pi}{6}$ and $\frac{\pi}{4}$ • recognise the graphs of $y=\sin x$, $y=\cos x$ and $y=\tan x$ on extended domains • examine amplitude changes and the graphs of $y=a\sin x$ and $y=a\cos x$ • examine period changes and the graphs of $y=\sin bx, y=\cos bx$ and $y=\tan bx$ • examine phase changes and the graphs of $y=\sin(x-c)$, $y=\cos(x-c)$ and $y=\tan(x-c)$ • examine the relationships $\sin\left(x+\frac{\pi}{2}\right)=\cos x$ and $\cos\left(x-\frac{\pi}{2}\right)=\sin x$ • prove and apply the angle sum and difference identities • identify contexts suitable for modelling by trigonometric functions and use them to solve practical problems • solve equations involving trigonometric functions using technology, and algebraically in simple cases
Week 15		**Revision and end of Unit 1 assessment**

Sample course outline

Mathematics Methods – ATAR Year 11

Unit 2

Time placement (and allocation)	Topic/s	Key teaching points – Syllabus reference/s
Weeks 16–18 (10 hours)	Topic 2.1: Exponential functions	**Indices and the index laws** (2.1.1 – 2.1.3) • review indices (including fractional and negative indices) and the index laws • use radicals and convert to and from fractional indices • understand and use scientific notation and significant figures **Exponential functions** (2.1.4 – 2.1.7) • establish and use the algebraic properties of exponential functions • recognise the qualitative features of the graph of $y = a^x$ $(a > 0)$, including asymptotes, and of its translations ($y = a^x + b$ and $y = a^{x-c}$) • identify contexts suitable for modelling by exponential functions and use them to solve practical problems • solve equations involving exponential functions using technology, and algebraically in simple cases
Weeks 18–19 (6 hours)	Topic 2.2: Arithmetic and geometric sequences and series	**Arithmetic sequences** (2.2.1 – 2.2.4) • recognise and use the recursive definition of an arithmetic sequence $t_{n+1} = t_n + d$ • develop and use the formula $t_n = t_1 + (n-1)d$ for the general term of an arithmetic sequence and recognise its linear nature • use arithmetic sequences in contexts involving discrete linear growth or decay, such as simple interest • establish and use the formula for the sum of the first n terms of an arithmetic sequence
Weeks 20–22 (9 hours)	Topic 2.2: Arithmetic and geometric sequences and series	**Geometric sequences** (2.2.5 – 2.2.9) • recognise and use the recursive definition of a geometric sequence $t_{n+1} = t_n r$ • develop and use the formula $t_n = t_1 r^{n-1}$ for the general term of a geometric sequence and recognise its exponential nature • understand the limiting behaviour as $n \to \infty$ of the terms t_n in a geometric sequence and its dependence on the value of the common ratio r • establish and use the formula $S_n = t_1 \frac{r^n - 1}{r - 1}$ for the sum of the first n terms of a geometric sequence • use geometric sequences in contexts involving geometric growth or decay, such as compound interest

Time placement (and allocation)	Topic/s	Key teaching points – Syllabus reference/s
Weeks 22–24 (9 hours)	Topic 2.3: Introduction to differential calculus	**Rates of change and the concept of the derivative** (2.3.1 – 2.3.9) • interpret the difference quotient $\frac{f(x+h)-f(x)}{h}$ as the average rate of change of a function f • use the Leibniz notation δx and δy for changes or increments in the variables x and y • use the notation $\frac{\delta y}{\delta x}$ for the difference quotient $\frac{f(x+h)-f(x)}{h}$ where $y = f(x)$ • interpret the ratios $\frac{f(x+h)-f(x)}{h}$ and $\frac{\delta y}{\delta x}$ as the slope or gradient of a chord or secant of the graph of $y = f(x)$ • examine the behaviour of the difference quotient $\frac{f(x+h)-f(x)}{h}$ as $h \to 0$ as an informal introduction to the concept of a limit • define the derivative $f'(x)$ as $\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ • use the Leibniz notation for the derivative: $\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x}$ and the correspondence $\frac{dy}{dx} = f'(x)$ where $y = f(x)$ • interpret the derivative as the instantaneous rate of change • interpret the derivative as the slope or gradient of a tangent line of the graph of $y = f(x)$
Weeks 24–26 (9 hours)	Topic 2.3: Introduction to differential calculus	**Computation and properties of derivatives** (2.3.10 – 2.3.15) • estimate numerically the value of a derivative for simple power functions • examine examples of variable rates of change of non-linear functions • establish the formula $\frac{d}{dx}(x^n) = nx^{n-1}$ for non-negative integers n expanding $(x+h)^n$ or by factorising $(x+h)^n - x^n$ • understand the concept of the derivative as a function • identify and use linearity properties of the derivative • calculate derivatives of polynomials
Weeks 26–29 (12 hours)	Topic 2.3: Introduction to differential calculus	**Applications of derivatives and anti-derivatives** (2.3.16 – 2.3.22) • determine instantaneous rates of change • determine the slope of a tangent and the equation of the tangent • construct and interpret position-time graphs with velocity as the slope of the tangent • recognise velocity as the first derivative of displacement with respect to time • sketch curves associated with simple polynomials, determine stationary points, and local and global maxima and minima, and examine behaviour as $x \to \infty$ and $x \to -\infty$ • solve optimisation problems arising in a variety of contexts involving polynomials on finite interval domains • calculate anti-derivatives of polynomial functions
Week 29–30		**Revision and end of course assessment**