Tables showing which M1 Maths modules relate to each Queensland Years 11-12 Specialist Mathematics element

The syllabus element is in the left column and the relevant module is in the right column.

Note that coverage of Specialist Maths by M1 Maths modules is very sporadic at present.

Unit 1 Topic 1 – Combinatorics

The inclusion–exclusion principle for the union of two sets and three sets (4 hours)	
Determine and use the formulas (including the addition principle) for finding the number of elements in the union of two and the union of three sets	
Use the multiplication principle.	A6-1 Combinations and the Binomial Expansion
Permutations (ordered arrangements) and combinations (unordered selections) (9 hours)	
solve problems involving permutations	A6-1 Combinations and the Binomial Expansion
use factorial notation	
use the notation ${}^nP_r = \frac{n!}{(n-r)!}$	
solve problems involving permutations with restrictions	
solve problems involving combinations	
use the notation $\binom{n}{r}$ and ${}^nC_r = \frac{n!}{r!(n-r)!}$	
derive and use simple identities associated with Pascal's triangle	
solve problems involving combinations with restrictions	
apply permutations and combinations to probability problems.	A6-1 Combinations and the Binomial Expansion
The pigeon-hole principle (2 hours)	
solve problems and prove results using the pigeon-hole principle.	

Unit 1 Topic 2 – Vectors in the Plane	
Representing vectors in the plane by directed line segments (6 hours)	
examine examples of vectors	N6-2 Vectors
understand the difference between a scalar and a vector	
define and use the magnitude and direction of a vector	
understand and use vector equality	
understand and use both the Cartesian form and polar form of a vector	
represent a scalar multiple of a vector	
use the triangle rule to find the sum and difference of two vectors	
Algebra of vectors in the plane (11 hours)	
use ordered pair notation and column vector notation to represent a vector	
understand and use vector notation: $\overrightarrow{AB}$, $\underset{\sim}{c}$, $\boldsymbol{d}$, unit vector notation $\hat{\boldsymbol{n}}$	N6-2 Vectors
convert between Cartesian form and polar form	
determine a vector between two points	
define and use unit vectors and the perpendicular unit vectors $\hat{\boldsymbol{\imath}}$ and $\hat{\boldsymbol{\jmath}}$	N6-2 Vectors
express a vector in component form using the unit vectors $\hat{\boldsymbol{\imath}}$ and $\hat{\boldsymbol{\jmath}}$	
examine and use addition and subtraction of vectors in component form	
define and use multiplication by a scalar of a vector in component form	
define and use a vector representing the midpoint of a line segment	
define and use scalar (dot) product	
apply the scalar product to vectors expressed in component form	
examine properties of parallel and perpendicular vectors and determine if two vectors are parallel or perpendicular	
define and use projections of vectors	
solve problems involving displacement, force, velocity, equilibrium and relative velocity involving the above concepts.	

Unit 1 Topic 3 – Introduction to Proof	
The nature of proof (5 hours)	
use implication, converse, equivalence, negation, contrapositive	
use proof by contradiction	A6-5 Further Methods of Proof
use the symbols for implication ($\Rightarrow$), equivalence ($\Leftrightarrow$), and equality (=)	
use the quantifiers ‘for all’ ($\forall$) and ‘there exists’ ($\exists$)	
use examples and counterexamples	A6-5 Further Methods of Proof
Rational and irrational numbers (4 hours)	
prove simple results involving numbers	A6-5 Further Methods of Proof
express rational numbers as terminating or eventually recurring decimals and vice versa	N2-1 Number Sets
prove irrationality by contradiction	A6-5 Further Methods of Proof
Circle properties and their proofs (8 hours)	
prove circle properties, such as - an angle in a semicircle is a right angle - the angle at the centre subtended by an arc of a circle is twice the angle at the circumference subtended by the same arc - angles at the circumference of a circle subtended by the same arc are equal - the opposite angles of a cyclic quadrilateral are supplementary - chords of equal length subtend equal angles at the centre and conversely chords subtending equal angles at the centre of a circle have the same length - a tangent drawn to a circle is perpendicular to the radius at the point of contact - the alternate segment theorem - when two chords of a circle intersect, the product of the lengths of the intervals on one chord equals the product of the lengths of the intervals on the other chord and its converse - when a secant (meeting the circle at A and B) and a tangent (meeting the circle at T) are drawn to a circle from an external point M, the square of the length of the tangent equals the product of the lengths to the circle on the secant; (AM x BM = TM2) and its converse	G2-2 Geometric Figures
solve problems finding unknown angles and lengths and prove further results using the circle properties listed above.	

Geometric proofs using vectors (6 hours)	
prove the diagonals of a parallelogram meet at right angles if and only if it is a rhombus	
prove midpoints of the sides of a quadrilateral join to form a parallelogram	
prove the sum of the squares of the lengths of a parallelogram's diagonals is equal to the sum of the squares of the lengths of the sides	
prove an angle in a semicircle is a right angle	

Unit 2 Topic 1 – Complex Numbers 1

Complex numbers (4 hours)	
define the imaginary number i as a root of the equation $x^2 = -1$	N6-1 Complex Numbers
use complex numbers in the form $a+bi$ where a and b are the real and imaginary parts	
determine and use complex conjugates	
perform complex-number arithmetic: addition, subtraction, multiplication and division	
The complex plane (the Argand plane) (5 hours)	
consider complex numbers as points in a plane with real and imaginary parts as Cartesian coordinates	N6-1 Complex Numbers
examine and use addition of complex numbers as vector addition in the complex plane	
understand and use location of complex conjugates in the complex plane	
examine and use multiplication as a linear transformation in the complex plane	
Complex arithmetic using polar form (3 hours)	
use the modulus $\|z\|$ of a complex number z and the argument $Arg(z)$ of a non-zero complex number z	N6-1 Complex Numbers
convert between Cartesian form and polar form	
define and use multiplication, division and powers of complex numbers in polar form and the geometric interpretation of these	
Roots of equations (3 hours)	
use the general solution of real quadratic equations	
determine complex conjugate solutions of real quadratic equations	
determine linear factors of real quadratic polynomials	

Unit 2 Topic 2 – Trigonometry and Functions	
The basic trigonometric functions (2 hours)	
find all solutions of $f(a(x-b)) = c$ where $f(\theta)$ is one of $\sin(\theta)$, $\cos(\theta)$ or $\tan(\theta)$	A5-12 Trigonometric Equations
sketch and graph functions with rules of the form $f(a(x-b)) = c$ where $f(\theta)$ is one of $\sin(\theta)$, $\cos(\theta)$ or $\tan(\theta)$	A5-11 Trigonometric Functions
Sketching graphs (6 hours)	
use and apply the notation $\|x\|$ for the absolute value for the real number x and the graph of $y=\|x\|$	A5-10 Further Relations
examine the relationship between the graph of $y=f(x)$ and the graphs of $y=1/f(x)$, $y=\|f(x)\|$ and $y=f(\|x\|)$	
sketch the graphs of simple rational functions where the numerator and denominator are polynomials of low degree	C6-13 Graph Sketching
The reciprocal trigonometric functions, secant, cosecant and cotangent (3 hours)	
define the reciprocal trigonometric functions, sketch their graphs, and graph simple transformations of them	
Trigonometric identities (9 hours)	
prove and apply the Pythagorean identities	M5-1 Unit Circle and Trig Identities
prove and apply the angle sum, difference and double-angle identities for sines and cosines	
prove and apply the identities for products of sines and cosines expressed as sums and differences	
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 $a\cos(x)+b\sin(x)=c$ and solve real-world problems	
use the binomial theorem to prove and apply multi-angle trigonometric identities up to $\sin(4x)$ and $\cos(4x)$	
Applications of trigonometric functions to model periodic phenomena (5 hours)	
model periodic motion using sine and cosine functions, and understand the relevance of the period and amplitude of these functions in the model	A5-11 Trigonometric Functions

Unit 2 Topic 3 – Matrices	
Matrix arithmetic (6 hours)	
understand the matrix definition and notation	
define and use addition and subtraction of matrices, scalar multiplication, matrix multiplication, multiplicative identity and multiplicative inverse	
calculate the determinant and inverse of 2 x 2 matrices algebraically and solve matrix equations of the form $\mathbf{AX}=\mathbf{B}$, where $\mathbf{A}$ is a 2 x 2 matrix and $\mathbf{X}$ and $\mathbf{B}$ are column vectors	
calculate the determinant and inverse of higher order matrices and solve matrix equations using technology	
Transformations in the plane (9 hours)	
understand translations and their representation as column vectors	
define and use basic linear transformations: dilations of the form $(x,y)\longrightarrow(ax,by)$, rotations about the origin and reflection in a line that passes through the origin, and the representations of these transformations by 2 x 2 matrices	
apply these transformations to points in the plane and geometric objects	
define and use composition of linear transformations and the corresponding matrix products	
define and use inverses of linear transformations and the relationship with the matrix inverse	
examine the relationship between the determinant and the effect of a linear transformation on area	
establish geometric results by matrix multiplications	

Unit 3 Topic 1 – Proof by Mathematical Induction	
Mathematical Induction (7 hours)	
understand the nature of inductive proof including the ‘initial statement’ and deductive step	A6-5 Further Methods of Proof
prove results for sums for any positive integer n	
prove divisibility results for any positive integer n.	

Unit 3 Topic 2 – Vectors and Matrices	
The algebra of vectors in three dimensions (4 hours)	
review the concepts of vectors from Unit 1 and extend to three dimensions by introducing the unit vector $\hat{\boldsymbol{k}}$ and the altitude φ	N6-2 Vectors
prove geometric results (review from the topic Geometric proofs using vectors) in the plane and construct simple proofs in three dimensions	
Vector and Cartesian equations (10 hours)	
introduce Cartesian coordinates for three-dimensional space, including plotting points and the equations of spheres	
use vector equations of curves in two or three dimensions involving a parameter, and determine a 'corresponding' Cartesian equation in the two-dimensional case	
determine a vector, parametric and Cartesian equation of a straight line and straight-line segment given the position of two points, or equivalent information, in both two and three dimensions	
examine the position of two particles, each described as a vector function of time, and determine if their	
define and use the vector (cross) product to determine a vector normal to a given plane	
use vector methods in applications, including areas of shapes and determining vector and Cartesian equations of a plane and of regions in a plane	
Systems of linear equations (6 hours)	
recognise the general form of a system of linear equations in several variables and use Gaussian techniques of elimination to solve a system of linear equations	
solve systems of linear equations using matrix algebra	
solve systems of linear equations using matrix algebra	
Applications of matrices (7 hours)	
model real-life situations using matrices, including Dominance and Leslie	
investigate how matrices have been applied in other real-life situations, e.g. Leontief, Markov, area, cryptology, eigenvectors and eigenvalues Note: The external examination may assess only Dominance and Leslie matrices.	

Vector calculus (5 hours)	
consider position of vectors as a function of time	
derive the Cartesian equation of a path given as a vector equation in two dimensions, including circles, ellipses and hyperbolas	
differentiate and integrate a vector function with respect to time	
determine equations of motion of a particle travelling in a straight line with both constant and variable acceleration	
apply vector calculus to motion in a plane, including projectile and circular motion	

Unit 3 Topic 3 – Complex Numbers 2	
Cartesian forms (4 hours)	
review real and imaginary parts $Re(z)$ and $Im(z)$ of a complex number z	N6-1 Complex Numbers
review Cartesian form	
review complex arithmetic using Cartesian form	
Complex arithmetic using polar form (3 hours)	
prove the identities involving modulus and argument	
prove and use De Moivre's theorem for integral powers	N6-1 Complex Numbers
The complex plane (the Argand plane) (2 hours)	
identify subsets of the complex plane determined by straight lines and circles	
Roots of complex numbers (3 hours)	
determine and examine the nth roots of unity and their location on the unit circle	
determine and examine the nth roots of complex numbers and their location in the complex plane	
Factorisation of polynomials (4 hours)	
prove and apply the factor theorem and the remainder theorem for polynomials	A5-1 Polynomial Functions
consider conjugate roots for polynomials with real coefficients	
solve polynomial equations to order 4	

Unit 4 Topic 1 – Integration and Applications of Integration	
Integration techniques (10 hours)	
integrate using the trigonometric identities $\sin^2(x) = ½ (1−\cos(2x))$, $\cos^2(x) = ½ (1+\cos(2x))$ and $1+\tan^2(x) =\sec^2(x)$	
use substitution $u=g(x)$ to integrate expressions of the form $f(g(x))\ g'(x)$	
establish and use the formula $\int(1/x)\ dx = \ln\|x\|+c$, for $x≠0$	C6-7 Other Derivatives
find and use the inverse trigonometric functions: arcsine, arccosine and arctangent	
find and use the derivative of the inverse trigonometric functions: arcsine, arccosine and arctangent	
integrate expressions of the form $\frac{\pm 1}{\sqrt{a^2-x^2}}$ and $\frac{a}{a^2+x^2}$	
use partial fractions where necessary for integration in simple cases	
integrate by parts	
Applications of integral calculus (9 hours)	
calculate areas between curves determined by functions	
determine volumes of solids of revolution about either axis	C6-10 Integration
use the numerical integration method of Simpson's rule, using technology	C6-15 Simpson's Rule
use and apply the probability density function, $f(t)=\lambda e^{-\lambda t}$ for $t≥0$, of the exponential random variable with parameter $\lambda>0$, and use the exponential random variables and associated probabilities and quantiles to model data and solve practical problems	

Unit 4 Topic 2 – Rates of Change and Differential Equations	
Rates of change (10 hours)	
use implicit differentiation to determine the gradient of curves whose equations are given in implicit form	
use related rates as instances of the chain rule: $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$	
solve simple first-order differential equations of the form $\frac{dy}{dx} = f(x)$, differential equations of the form $\frac{dy}{dx} =g(y)$ and, in general, differential equations of the form $\frac{dy}{dx} =f(x)g(y)$ using separation of variables	C6-9 Differential Equations
examine slope (direction or gradient) fields of a first-order differential equation	

formulate and use differential equations, including the logistic equation, e.g. examples in chemistry, biology and economics	
Modelling motion (10 hours)	
examine momentum, force, resultant force, action and reaction	
consider constant and non-constant force	
understand motion of a body under concurrent forces	
consider and solve problems involving motion in a straight line with both constant and non-constant acceleration, including simple harmonic motion and the use of expressions $\frac{dv}{dt}$, $\frac{d^2x}{dt^2}$, $v\frac{dv}{dt}$ and $\frac{d(\frac{1}{2}v^2)}{dx}$ for acceleration	

Unit 4 Topic 3 – Statistical Inference	
Sample means (8 hours)	
examine the concept of the sample mean $\bar{X}$ as a random variable whose value varies between samples where X is a random variable with mean μ and the standard deviation σ	P6-8 Confidence Intervals for Means
simulate repeated random sampling from a variety of distributions and a range of sample sizes to illustrate properties of the distribution of $\bar{X}$ across samples of a fixed size n, including its mean μ, its standard deviation $\sigma/\sqrt{n}$ (where μ and σ are the mean and standard deviation of X) and its approximate normality if n is large	
simulate repeated random sampling from a variety of distributions and a range of sample sizes to illustrate the approximate standard normality of $\frac{\bar{X}-\mu}{(s/\sqrt{n})}$ for large samples (n≥30), where s is the sample standard deviation	
Confidence intervals for means (8 hours)	
understand the concept of an interval estimate for a parameter associated with a random variable	P6-8 Confidence Intervals for Means
examine the approximate confidence interval $\left(\bar{x} - z\frac{s}{\sqrt{n}}, \bar{x} + z\frac{s}{\sqrt{n}}\right)$, as an interval estimate for μ, the population mean, where z is the appropriate quantile for the standard normal distribution	
use simulation to illustrate variations in confidence intervals between samples and to show that most but not all confidence intervals contain μ	
use $\bar{x}$ and s to estimate μ and σ, to obtain approximate intervals covering desired proportions of values of a normal random variable and compare with an approximate confidence interval for μ	

collect data and construct an approximate confidence interval to estimate a mean and to report on survey procedures and data quality	