

Units 1 and 2: Mathematical Methods - Summary of Topics covered:

Note this description has been adapted from the official VCAA Study Design which is available at <http://www.vcaa.vic.edu.au/documents/vce/mathematics/mathstd.pdf> if you would like a more detailed description of the course. It is important to note that the course done at VCE requires the use of a CAS calculator, whereas courses at the University of Melbourne do not use calculators at all. So if you are using a text book designed for the VCE course some of the technology dependent questions will not be relevant.

Mathematical Methods Units 1 and 2 are designed as preparation for Mathematical Methods Units 3 and 4.

Students are expected to be able to apply techniques, routines and processes involving rational and real arithmetic, algebraic manipulation, equation solving, graph sketching, differentiation and integration without the use of technology, as applicable. Students should be familiar with relevant mental and by hand approaches in simple cases.

Familiarity with determining the equation of a straight line from combinations of sufficient information about points on the line or the gradient of the line and familiarity with Pythagoras theorem and its application to finding the distance between two points is assumed. Students should also be familiar with quadratic, exponential, logarithmic and trigonometric functions, algebra and graphs, and basic concepts of probability.

The areas of study for Unit 1 & 2 are:

- **Functions and graphs** - This area of study will include:
 - distance between two points in the cartesian plane, coordinates of the midpoint of a line segment, and gradients of parallel and perpendicular lines;
 - use of the notation $y = f(x)$ for describing the rule of a function and evaluation of $f(a)$, where a is a real number or a symbolic expression;
 - graphs of power functions $y = x^n$ for $n \in \mathbb{N}$ and $n = -1, -2, 1, 2$ and transformations of these to the form $y = a(x + b)^n + c$ where a, b and $c \in \mathbb{R}$;
 - graphs of polynomial functions to degree 4;
 - qualitative interpretation of features of graphs, and families of graphs, including an informal consideration of rates of change;
 - ‘the vertical line test’ and its use to determine whether a relation is a function;
 - graphs of relations including those specified by conditions or constraints, such as arcs of circles or a region defined by an inequality, for example ‘the set of all points whose distance from a fixed point (a, b) is less than a given value’;
 - graphs of inverse relations.

- **Algebra** - This area of study will include:
 - use of symbolic notation to develop algebraic expressions and represent functions, relations and equations;
 - substitution into, manipulation, expansion and factorisation of algebraic expressions, including the remainder and factor theorems;
 - recognition of equivalent expressions and simplification of algebraic expressions involving functions and relations, including use of exponent laws and logarithm laws;
 - determination of rules of simple functions and relations from given information, including polynomial functions to degree 4 and of transformations (dilation, reflection and translation) of the square root and circle relations;
 - solution of polynomial equations to degree 4, analytically, numerically and graphically;
 - use of inverse functions to solve equations;
 - solution of equations of the form $Af(bx) + c = k$, where A, b, c and $k \in \mathbb{R}$, and f is sine, cosine, tangent or a^x using exact or approximate values on a given domain, and interpretation of these equations;
 - the connection between factors of $f(x)$, solutions of the equation $f(x) = 0$ and the horizontal axis intercepts of the graph of the function f ;
 - solution and interpretation of simultaneous equations involving two functions by numerical, graphical and analytical methods;
 - use of parameters to represent a family of functions and general solutions of equations involving these functions;
 - development of polynomial models;
 - index laws and logarithm laws, including their application to the solution of simple exponential equations;
 - application of matrices to transformations of points in the plane (dilation from the coordinate axes; reflection in the coordinate axes and the line $y = x$, and translation from the coordinate axes), and the solution of systems of simultaneous linear equations in up to four unknowns.
- **Rates of change and calculus** - This area of study will include:
 - average and instantaneous rates of change:
 - rate of change of a linear function, use of gradient as a measure of rate of change;
 - average rate of change, use of the gradient of a chord of a graph to describe average rate of change of $y = f(x)$ with respect to x , over a given interval;
 - the measurement of rates of change of polynomial functions;

- tangents to curves and local linearity of differentiable curves, use of gradient of a tangent at a point on the curve to describe instantaneous rate of change of $y = f(x)$ with respect to x :
 - graphs of functions and interpretation of the rate of change of a function, where the rate of change is positive, negative, or zero, relationship of the gradient function to features of the original function;
 - motion graphs, construction and interpretation of displacement–time and velocity–time graphs and informal treatment of the relationship between displacement–time and velocity–time graphs;
 - use of rates of change and corresponding graphs in other contexts, such as describing the rate of change of heartbeat during an exercise sequence or the rate of change of the height of water in a container that is being filled at a constant rate.

- **Probability** - This area of study will include:
 - random experiments, events and event spaces;
 - probability as an expression of long run proportion;
 - simulation using simple generators such as coins, dice, spinners, random number tables and technology;
 - display and interpretation of results of simulations;
 - probability of simple and compound events;
 - lists, grids, venn diagrams, Karnaugh maps and tree diagrams;
 - the addition rule for probabilities;
 - conditional probability;
 - independence, and the multiplication rule for independent events.