Mathematics Methods - Foundation

LEVEL 3	15 TCE CREDIT POINTS
COURSE CODE	MTM315117
COURSE SPAN	2017 — 2023
READING AND WRITING STANDARD	NO
MATHEMATICS STANDARD	YES
COMPUTERS AND INTERNET STANDARD	NO

This course was delivered in 2017. Use A-Z Courses to find the current version (if available).

Mathematics is the study of order, relation and pattern

From its origins in counting and measuring it has evolved in highly sophisticated and elegant ways to become the language now used to describe much of the modern world. Mathematics is also concerned with collecting, analysing, modelling and interpreting data in order to investigate and understand real-world phenomena and solve problems in context. Mathematics provides a framework for thinking and a means of communication that is powerful, logical, concise and precise. It impacts upon the daily life of people everywhere and helps them to understand the world in which they live and work. Mathematics Methods – Foundation Level 3 provides for the study of algebra, functions and their graphs, calculus, probability and statistics. These are necessary prerequisites for the study of Mathematics Methods Level 4 in which the major themes are calculus and statistics. For these reasons this subject provides a foundation for study of Mathematics Methods Level 4 and disciplines in which mathematics has an important role, including engineering, the sciences, commerce, economics, health and social sciences.

Course Description

Mathematics Methods – Foundation Level 3 provides an introductory study of algebra, functions and their graphs, calculus, probability and statistics. It is designed as a preparation course for the study of Mathematics Methods Level 4 and covers assumed knowledge and skills required for that course.

Rationale

Mathematics is the study of order, relation and pattern. From its origins in counting and measuring it has evolved in highly sophisticated and elegant ways to become the language now used to describe much of the modern world. Mathematics is also concerned with collecting, analysing, modelling and interpreting data in order to investigate and understand real-world phenomena and solve problems in context. Mathematics provides a framework for thinking and a means of communication that is powerful, logical, concise and precise. It impacts upon the daily life of people everywhere and helps them to understand the world in which they live and work.

Mathematics Methods – Foundation Level 3 provides for the study of algebra, functions and their graphs, calculus, probability and statistics. These are necessary prerequisites for the study of Mathematics Methods Level 4 in which the major themes are calculus and statistics. For these reasons this subject provides a foundation for study of Mathematics Methods Level 4 and disciplines in which mathematics has an important role, including engineering, the sciences, commerce, economics, health and social sciences.

Aims

Mathematics Methods – Foundation Level 3 aims to develop learners':

- understanding of concepts and techniques and problem solving ability in the areas of algebra, function study, differential and integral calculus, probability and statistics
- reasoning skills in mathematical contexts and in interpreting mathematical information
- capacity to communicate in a concise and systematic manner using mathematical language.

Learning Outcomes

On successful completion of this course, learners will be able to:

1. organise and undertake activities including practical tasks
2. explain key concepts and techniques used in solving problems
3. solve problems using algebra, functions, graphs, calculus, probability and statistics
4. apply reasoning skills in the context of algebra, functions, graphs, calculus, probability and statistics
5. interpret and evaluate mathematical information and ascertain the reasonableness of solutions to problems
6. communicate their arguments and strategies when solving problems
7. choose when or when not to use technology when solving problems
8. Additionally, learners will be given opportunities to demonstrate the following in line with Australian Curriculum General Capabilities: literacy skills; numeracy skills; information and communication technology skills; critical and creative thinking skills; ethical and intercultural understanding.

Pathways

Mathematics Methods – Foundation Level 3 is designed for learners whose future pathways may involve the study of further secondary mathematics or a range of disciplines at the tertiary level. It functions as a foundation course for the study of Mathematics Methods Level 4.

It is recommended that learners attempting this course will be concurrently studying Grade 10 *Australian Curriculum: Mathematics* or have previously achieved at least a 'B' grade in that subject.

Resource Requirements

Programs of study derived from this course need to embrace the range of technological developments that have occurred in relation to mathematics teaching and learning.

Learners must have access to calculator algebraic system (CAS) graphics calculators and become proficient in their use. These calculators can be used in all aspects of this course in the development of concepts and as a tool for solving problems. Refer to *'What can I take to my exam?'* for the current TASC Calculator Policy that applies to Level 3 and Level 4 courses.

The use of computer software is also recommended as an aid to students' learning and mathematical development. A range of packages such as, but not limited to: *Wolfram Mathematica*, *Microsoft Excel*, *Autograph*, *Efofex Stat*, *Graph* and *Draw* are appropriate for this purpose.

Course Size And Complexity

This course has a complexity level of 3.

At Level 3, the learner is expected to acquire a combination of theoretical and/or technical and factual knowledge and skills and use judgement when varying procedures to deal with unusual or unexpected aspects that may arise. Some skills in organising self and others are expected. Level 3 is a standard suitable to prepare learners for further study at the tertiary level. VET competencies at this level are often those characteristic of an AQF Certificate III.

This course has a size value of 15.

Course Requirements

This course is made up of **five (5)** areas of study. While each of these is **compulsory**, the order of delivery is not prescribed:

- Algebra
- Polynomial functions and graphs
- Exponential, logarithmic and circular (trigonometric) functions and graphs
- Calculus
- Probability and statistics.

These areas of mathematics relate to the Assessment Criteria 4 to 8. Assessment Criteria 1 to 3 apply to all five areas of study.

Course Content

ALGEBRA

Learners will be introduced to relevant conventions relating to algebraic language and notation. They will review then further develop their skills in the algebraic manipulation of simple polynomial functions (linear, quadratic and cubic) in the context of their function study work.

This area of study will include:

Review work:

- using symbolic notation to develop algebraic expressions and represent functions, equations and systems of simultaneous equations
- substituting into and manipulation of expressions
- rearranging formulae
- using the notation $y = f(x)$; substitution and evaluation of $f(a)$ where a is real.

Quadratic functions:

- expanding quadratics from factors
- factorising using:
    - connections between factors, roots, zeros and corresponding graphs of quadratics functions
    - perfect squares and difference of squares
    - 'completion of square' method for monic and non-monic trinomials

- solving quadratic equations: obtaining rational solutions by simple iteration, graphing or obtaining rational and irrational solutions by 'completion of the square' and by the quadratic formula
- using the discriminant: $\Delta = b^2 - 4ac$ to determine if a quadratic has real factors and whether such factors are rational or irrational
- using the 'completion of the square' method for finding maximum or minimum values of quadratic functions.

Powers and Polynomials:

- identifying key features of polynomials: variables, coefficients and degree
- expanding $(ax \pm by)^n$ for $n = 2 \ \text{ to } \ 5$ using Pascal's triangle, where a and b are natural numbers
- using $\binom{n}{r}$ or $^{n}C_{r}$ to generate binomial coefficients, as coefficients in the expansion of $(ax \pm by)^n$, for $n = 2 \ \text{ to } \ 5$.

Cubic functions:

- expanding cubics from factors
- factorising:
    - using connections between factors, roots, zeros and corresponding graphs of cubic functions
    - using the factor theorem, limited to cubics with at least one factor of the form $(x - a)$ where a is an integer
    - using the sum and difference of cubes
    - cubic polynomials using technology and algebraically in cases where a linear function is easily determined

- solving cubic equations by either graphing (including cases that do not have three solutions) or utilising algebraic methods: for example, factorising cubics that have at least one integer zero.

Indices:

- reviewing indices (including rational indices) and the index laws
- using surds (radicals) to convert to and from rational indices
- reviewing the use of scientific notation
- solving equations using indices.

POLYNOMIAL FUNCTIONS AND GRAPHS

Learners will develop their understanding of the behaviour of a range of functions by sketching and analysing polynomials of degree no higher than three.

This area of study will include:

Linear functions:

- recognising examples of direct proportion and linear related variables
- recognising features of the graph of $y = mx + c$ including its linear nature, its intercepts and the gradient
- finding equations of straight lines from given information; parallel and perpendicular lines
- solving linear equations.

Quadratic functions:

- recognising examples of quadratically related variables
- recognising features of the graphs $y = x^2$, $y = a(x - b)^2 + c$, and $y = a(x - b)(x - c)$ (zeros, y-intercepts and turning points as applicable)
- solving quadratic equations using the quadratic formula and by completing the square
- recognising features of the graph of the general quadratic: $y = ax^2 + bx + c$ (zeros, y-intercepts, turning point as applicable)
- finding turning points and zeros of quadratics and understand the role of the discriminant $\Delta = b^2 - 4ac$
- sketching graphs of quadratic functions: $y = ax^2 + bx + c$ when given information about the signs of a, b, c and $b^2 - 4ac$
- examining translations of quadratic functions; graphs of $y = f(x) + a$ and $y = f(x + b)$
- examining the dilations and reflections of quadratic functions; graphs of $y = cf(x)$ and $y = f(dx)$
- using quadratic functions to solve presented modelled practical scenarios.

Cubic and other polynomial functions:

- identifying the coefficients and the degree of a polynomial
- expanding cubic polynomials from factors
- factorising cubic polynomials in cases where a linear factor is easily obtained
- recognising features of the graphs of $y = x^3$, $y = a(x - h)^3 + k$ and $y = k(x - a)(x - b)(x - c)$ including shape, intercepts and behaviour as $x \to \infty$ and $x \to -\infty$
- finding the equation of a cubic function given sufficient information (such as, when applicable, the point of inflection, y-intercept, zeros, or a point value)
- solving cubic equations using technology and algebraically in cases, using the factor theorem where a linear factor is easily obtained

- examining translations of cubic functions: graphs of $y = f(x) + a$ and $y = f(x + b)$
- examining the dilations and reflections of cubic function: graphs of $y = cf(x)$ and $y = f(dx)$
- using cubic functions to solve presented modelled practical scenarios
- identifying the general features of the graphs of $y = x^n$ for $n \in N$, $n = -1$ and $n = \frac{1}{2}$, including shape and behaviour as $x \to \infty$ and $x \to -\infty$ (introductory, non-examinable treatment only).

Language of functions:

- understanding 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
- recognising the distinction between functions and relations, using examples of relations such as the circle or $x = y^2$
- using function notation, domain, range, independent and dependent variables.

EXPONENTIAL, LOGARITHMIC AND CIRCULAR (TRIGONOMETRIC) FUNCTIONS AND GRAPHS

Learners will develop their understanding of the behaviour of exponential, logarithmic and a range of circular (trigonometric) functions.

This area of study will include:

Exponential functions:

- establishing and using the algebraic properties of exponential functions
- recognising the qualitative features of the graph of $y = b^x$ ($a > 0$) including asymptotes, intercepts and simple translations: $y = a \times b^x + k$
- solving equations involving exponential functions using technology and algebraically in simple cases
- using function notation, domain, range, independent and dependent variables
- examining simple applications of exponential functions such as growth and decay, compound interest, inflation and depreciation.

Logarithmic functions:

- defining logarithms as indices: $a^x = b$ is equivalent to $x = \log_a b$, i.e. $a^{\log_a b} = b$
- recognising the inverse relationship between logarithms and exponentials: $y = a^x$ is equivalent to $x = \log_a y$
- solving simple equations involving logarithmic functions algebraically and graphically
- recognising the qualitative features of the graph of $y = \log_n x$ ($n > 1$) including asymptotes, intercepts and of the translations: $y = a \log_n (x - h) + k$
- solving simple equations involving logarithmic functions algebraically and graphically
- using function notation, domain, range, independent and dependent variables
- examining simple applications of logarithmic functions.

Circular (Trigonometric) functions:

- using arc length as an introduction to radian measure
- using radian measure and its relationship with degree measure

- reviewing sine, cosine and tangent as ratios of side lengths in right-angled triangles
- using the sine and cosine rules for a triangle in straight-forward cases where a diagram of the triangle is given
- using the unit circle definitions of $\cos\theta$, $\sin\theta$ and $\tan\theta$, and periodicity using radians and the properties that arise from these definitions
  - the (Pythagorean) relationship $\sin^2 x + \cos^2 x = 1$
  - basic symmetry properties such as $\sin(\pi \pm x)$, $\cos(\pi \pm x)$, $\sin(2\pi \pm x)$, $\cos(2\pi \pm x)$, $\tan(\pi \pm x)$, $\tan(2\pi \pm x)$
- recognising the exact values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in the four quadrants at integer multiples of $\frac{\pi}{6}$, $\frac{\pi}{4}$, $\frac{\pi}{3}$ and $\frac{\pi}{2}$
- recognising the graphs of $y = \sin x$, $y = \cos x$ and $y = \tan x$ on extended domains
- examining period changes, dilations and reflections (about the x–axis) of the graphs of $y = a\sin bx$ and $y = a\cos bx$
- examining period changes and the graphs of $y = \tan bx$
- using function notation, domain and range.

CALCULUS

Learners will develop an intuitive understanding of instantaneous rates of change through familiar situations, and through a graphical and numerical approach to the measurement of constant, average and instantaneous rates of change. This area of study progresses to the differentiation of polynomials of degree no higher than three. Extension to maximising problems, where the required expression is not given, is not required.

This area of study will include:

- using the concepts of average and instantaneous rates of change in a variety of practical contexts
- using the gradient as a measure of rate of change of a linear function
- using the gradient of a tangent at a point on the graph of a function to describe and measure the instantaneous rate of change of the function, including consideration of where the rate of change is positive, negative or zero and the relationship of the gradient function to features of the original function
- using the gradient of a chord of a graph to describe the average rate of change of $y = f(x)$ with respect to x over a given interval
- interpreting the derivative as the slope or gradient of a tangent line of the graph of $y = f(x)$
- using the notations for the derivative of a function: $\frac{dy}{dx}$, $f\prime(x)$, $\frac{df(x)}{dx}$, $y\prime(x)$
- using the concept of the derivative, $\frac{d}{dx}(kx^n) = nkx^{n-1}$, as a function
- calculating derivatives of simple polynomials with rational or negative powers by rule
- applying the derivative to:
  - finding instantaneous rates of change
  - finding the slope of a tangent and the equations of a tangent and a normal to a curve at a point
  - sketching graphs of and analysing graphs associated with quadratic and cubic functions, finding stationary points, and the local maxima and minima and examining behaviour as $x \to \infty$ and $x \to -\infty$
  - sketching graphs of the derivative function when turning points are given
  - constructing and interpreting position/displacement-time graphs, with velocity as the slope of the tangent

- investigating the concept of and the evaluation of a limit, e.g. $\lim_{x \to a} f(x) = p$
- examining 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
- a formalisation of the first principles approach to the differentiation of derivative $f(x) = x^n$, for $n = 1, 2 \text{ and } 3$ for simple quadratic functions.

PROBABILITY AND STATISTICS

Learners will develop counting techniques required for the calculation of probabilities and gain an understanding of the related concepts of conditional and independent events.

This area of study will include:

Reviewing the fundamentals of probability and the language of events and sets:

- using random experiments, which could include simple random generators, sample spaces, outcomes, elementary and compound events
- defining probability as a measure of 'the likelihood of the occurrence' of an event

- using the probability scale: $0 \leq P(A) \leq 1$ for each event A, with $P(A) = 0$ if A is an impossibility and $P(A) = 1$ if A is a certainty
- using the concepts and language of outcomes, sample spaces and events as sets of outcomes
- using relative frequencies obtained from data as point estimates of probabilities
- investigating the probability of simple and compound events, representing these as lists, grids, Venn diagrams and tree diagrams
- using set language and notation for events, including $\overline{A}$ (or $A\prime$) for the complement of an event A, $A \cap B$ for the intersection of events A and B, and $A \cup B$ for the union of events, and recognise mutually exclusive events
- using everyday occurrences to illustrate set descriptions and representations of events and set operations
- using the rules: $P\left(\overline{A}\right) = 1 - P(A)$ and the addition rule for probability $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, and the relation for mutually exclusive events where $P(A \cap B) = 0$, hence $P(A \cup B) = P(A) + P(B)$.

Conditional probability and independence:

- defining the notion of conditional probability and recognising and using language that indicates conditionality
- using the notation $P(A \mid B)$ and the formula $P(A \cap B) = P(A \mid B).P(B)$
- using the notion of independence of an event A from an event B, as defined by $P(A \mid B) = P(A)$
- establishing and using the formula $P(A \cap B) = P(A).P(B)$ for independent events A and B, recognising the symmetry of independence
- using relative frequencies obtained from data as point estimates of conditional probabilities and as indications of possible independence of events.

Combinations:

- understanding the notion of a combination as a set of r ordered objects taken from a set of n distinct objects without regard to order
- using the notation ${}^{n}C_{r}$ or $\binom{n}{r}$ 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.

Assessment

Criterion-based assessment is a form of outcomes assessment that identifies the extent of learner achievement at an appropriate end-point of study. Although assessment – as part of the learning program – is continuous, much of it is formative, and is done to help learners identify what they need to do to attain the maximum benefit from their study of the course. Therefore, assessment for summative reporting to TASC will focus on what both teacher and learner understand to reflect end-point achievement.

The standard of achievement each learner attains on each criterion is recorded as a rating 'A', 'B', or 'C', according to the outcomes specified in the standards section of the course.

A 't' notation must be used where a learner demonstrates any achievement against a criterion less than the standard specified for the 'C' rating.

A 'z' notation is to be used where a learner provides no evidence of achievement at all.

Providers offering this course must participate in quality assurance processes specified by TASC to ensure provider validity and comparability of standards across all awards. To learn more, see TASC's quality assurance processes and assessment information.

Internal assessment of all criteria will be made by the provider. Providers will report the learner's rating for each criterion to TASC.

TASC will supervise the external assessment of designated criteria which will be indicated by an asterisk (*). The ratings obtained from the external assessments will be used in addition to internal ratings from the provider to determine the final award.

Quality Assurance Process

The following processes will be facilitated by TASC to ensure there is:

- a match between the standards of achievement specified in the course and the skills and knowledge demonstrated by learners
- community confidence in the integrity and meaning of the qualification.

Process – TASC gives course providers feedback about any systematic differences in the relationship of their internal and external assessments and, where appropriate, seeks further evidence through audit and requires corrective action in the future.

External Assessment Requirements

The external assessment for this course will comprise:

- a three hour written examination assessing criteria: 4, 5, 6, 7 and 8.

For further information see the current external assessment specifications and guidelines for this course available in the Supporting Documents below.

Criteria

The assessment for Mathematics Methods - Foundation Level 3 will be based on the degree to which the learner can:

1. communicate mathematical ideas and information
2. apply mathematical reasoning and strategy in problem solving situations
3. use resources and organisational strategies
4. manipulate algebraic expressions and solve equations*
5. understand linear, quadratic and cubic functions*
6. understand logarithmic, exponential and trigonometric functions*
7. use differential calculus in the study of functions*
8. understand experimental and theoretical probabilities and of statistics*

* = denotes criteria that are both internally and externally assessed

Standards

Criterion 1: communicate mathematical ideas and information

The learner:

Rating A	Rating B	Rating C
presents work that conveys a logical line of reasoning that has been followed between question and answer	presents work that conveys a line of reasoning that has been followed between question and answer	presents work that shows some of the mathematical processes that have been followed between question and answer
uses mathematical conventions and symbols correctly	uses mathematical conventions and symbols correctly	uses mathematical conventions and symbols. There may be some errors or omissions in doing so.
presents work with the final answer clearly identified and articulated in terms of the question as required	presents work with the final answer clearly identified	presents work with the final answer apparent
uses correct units and includes them in an answer for routine and non-routine problems	uses correct units and includes them in an answer for routine problems	uses correct units and includes them in an answer for routine problems
presents detailed tables, graphs and diagrams that convey accurate meaning and precise information	presents detailed tables, graphs and diagrams that convey clear meaning	presents tables, graphs and diagrams that include some suitable annotations
adds a detailed diagram to illustrate and explain a solution	adds a diagram to illustrate a solution	adds a diagram to a solution as directed
ensures an appropriate degree of accuracy is maintained and communicated throughout a problem.	determines and works to an appropriate degree of accuracy.	works to an appropriate degree of accuracy as directed.

Criterion 2: apply mathematical reasoning and strategy in problem solving situations

The learner:

Rating A	Rating B	Rating C
selects and applies an appropriate strategy, where several may exist, to solve routine and non-routine problems	selects and applies an appropriate strategy to solve routine and simple non-routine problems	identifies an appropriate strategy to solve routine problems
interprets solutions to routine and non-routine problems	interprets solutions to routine and simple non-routine problems	describes solutions to routine problems
explains the reasonableness of results and solutions to routine problems and non-routine problems	describes the reasonableness of results and solutions to routine problems	with direction, describes the reasonableness of results and solutions to routine problems
identifies and describes limitations of simple models	identifies and describes limitations of simple models	identifies limitations of simple models
uses available technological aids in familiar and unfamiliar contexts	chooses to use available technological aids when appropriate to solve routine problems	uses available technological aids to solve routine problems

models and solves problems derived from routine and non-routine scenarios.	models and solves problems derived from routine scenarios.	

Criterion 3: use resources and organisational strategies

The learner:

Rating A	Rating B	Rating C
uses planning tools and strategies to achieve and manage activities within proposed times	uses planning tools to achieve objectives within proposed times	uses planning tools, with prompting, to achieve objectives within proposed times
divides a task into appropriate sub-tasks	divides a task into sub-tasks	divides a task into sub-tasks as directed
selects strategies and formulae to successfully complete routine and non-routine problems	selects from a range of strategies and formulae to successfully complete routine problems	uses given strategies and formulae to successfully complete routine problems
plans timelines and monitors and analyses progress towards meeting goals, making adjustments as required	plans timelines and monitors progress towards meeting goals	monitors progress towards meeting goals
accurately and succinctly addresses all of the required elements of a task	addresses the elements of required tasks	addresses most elements of required tasks
plans future actions, effectively adjusting goals and plans where necessary.	plans future actions, adjusting goals and plans where necessary.	uses prescribed strategies to adjust goals and plans where necessary.

Criterion 4: manipulate algebraic expressions and solve equations

This criterion is both internally and externally assessed.

Rating 'A'
In addition to the standards for a 'C' and a 'B' rating, the learner:

Rating 'B'
In addition to the standards for a 'C' rating, the learner:

Rating 'C'
The learner:

Rating A	Rating B	Rating C
uses index laws to simplify expressions in the context of solving problems	uses index laws, including the use of surds (radicals), to simplify expressions with rational indices	uses index laws to simplify expressions with integral indices
simplifies and manipulates algebraic expressions in the course of solving problems or making calculations	applies routine calculations and manipulations with algebraic fractions to simplify expressions	performs routine calculations and manipulations with algebraic fractions
selects when to expand and when to leave expressions in factorised form		expands quadratic and cubic expressions from factors
expands binomial expressions using the binomial theorem	expands binomial expressions using Pascal's triangle	expands simple binomial expressions using Pascal's triangle

factorises algebraic expressions including sums and differences of cubes	factorises algebraic expressions, including methods such as monic and non-monic quadratics	factorises algebraic expressions involving a combination of methods such as, common factors, difference of squares and factorisation of monic quadratics
applies knowledge of the discriminant to analyse and interpret problems	uses the discriminant to determine whether or not the real zero of a quadratic is rational or irrational	uses the discriminant to determine whether or not a quadratic expression factorises with real factors
forms and solves simultaneous equations from applied scenarios in routine and non-routine problems including simple non-linear situations	solves simultaneous equations from applied scenarios in routine problems	solves simultaneous equations involving two linear functions
completes the square in a quadratic expression where the coefficient of the squared term is any integral value	completes the square in a quadratic expression where the coefficient of the squared term is 1	
solves quadratic equations and interprets solutions in the context of the problem posed	solves quadratic equations using the general quadratic formula	solves quadratic equations in factored form using the null factor law
selects methodologies for factorising cubic polynomials and solving cubic equations in the context of solving problems.	factorises cubic polynomials and solves cubic equations algebraically when one factor is linear, and otherwise using technology.	solves cubic polynomials when presented in factorised form, and otherwise using technology.

* denotes criteria that are both internally and externally assessed

Criterion 5: understand linear, quadratic and cubic functions

This criterion is both internally and externally assessed.

Rating 'A'
In addition to the standards for a 'C' and a 'B' rating, the learner:

Rating 'B'
In addition to the standards for a 'C' rating,the learner:

Rating 'C'
The learner:

Rating A	Rating B	Rating C
		finds the gradient of a straight line function
determines equations of parallel and perpendicular lines, and chooses to do so in the context of solving a problem	determines equations of parallel lines	given some properties of a line, such as the gradient and point, or two points on the line, determines and interprets its equation and/or sketches its graph
sketches quadratic functions $y = ax^2 + bx + c$ given information about the signs of a, b, c and the discriminant, $b^2 - 4ac$	determines intercepts, axis of symmetry, turning point, domain and range of a quadratic function	sketches factorised quadratic functions specifying intercepts
sketches graphs of cubic polynomials requiring factorisation and/or algebraic manipulation	sketches factorised cubic functions which may involve repeated zeros	sketches factorised cubic functions with three distinct linear factors specifying intercepts
determines and interprets the equation of a quadratic function given in graphical form or	interprets the key features of a quadratic function given in	employs a given quadratic function to address questions requiring substitution of values in a modelled scenario

via some vital characteristics, in a modelled scenario	graphical form in a modelled scenario	
determines and interprets the equation of a cubic function given in graphical form	interprets the equation of a cubic function given in graphical form	employs a given cubic function to address questions requiring substitution of values
can identify whether a graph or an equation is a function or a relation	can define the domain and the range of a function and understands the difference between a relation and a function	can interpret given information about the domain and range of a function
applies knowledge of translations to sketch graphs of polynomials.	applies knowledge of translations to sketch graphs of polynomials involving one translation.	uses key features to distinguish graphs of linear, quadratic and cubic functions.

* denotes criteria that are both internally and externally assessed

Criterion 6: understand logarithmic, exponential and trigonometric functions

This criterion is both internally and externally assessed.

Rating 'A'
In addition to the standards for a 'C' and a 'B' rating, the learner:

Rating 'B'
In addition to the standards for a 'C' rating, the learner:

Rating 'C'
The learner:

Rating A	Rating B	Rating C
solves more complex equations using index laws	solves routine equations using index laws	solves simple equations using index laws
solves more complex logarithmic equations and exponential equations using logarithms	solves simple logarithmic equations using log laws	uses the definition of log to change between a log statement and an index statement
establishes and solves exponential equations modelling real world scenarios	solves routine exponential problems including those requiring some interpretation of real world scenarios	applies knowledge of bases and order conventions to manipulate and solve simple exponential equations
sketches the graph of an exponential function, including horizontal and/or vertical translations, including asymptote(s) and intercept(s)	sketches the graph of an exponential function, including asymptote and intercepts, and identifies the domain and range	sketches the graph of a simple exponential function using technology
sketches the graph of a simple logarithmic function, including horizontal and vertical translations	sketches the graph of a simple logarithmic function, including asymptote and intercepts, and identifies the domain and range	sketches the graph of a simple logarithmic function using technology
	determines unknown sides and angles using sine and cosine rules where appropriate	determines side lengths using sine, cosine and tangent ratios in a given right angle triangle and sine and cosine rules in straight-forward problems
flexibly works with radians or degrees as appropriate to given contexts, and integrates knowledge of exact values with symmetry properties	converts between degrees and radians for general rotations	converts between radian and degree measures for simple rotations: 30^o, 45^o, 60^o, 90^o, 180^o and 360^o

applies symmetry properties to general rotations	applies symmetry properties arising from the unit circle for rotations between 0 and 2π radians	recalls the unit circle definitions of sine, cosine and tangent
sketches graphs of these functions, incorporating dilations and reflections and changes in period as applicable, with and without technology.	sketches graphs of these functions with and without technology.	sketches graphs of sine, cosine and tangent functions using technology.

* denotes criteria that are both internally and externally assessed

Criterion 7: use differential calculus in the study of functions

This criterion is both internally and externally assessed.

Rating 'A'
In addition to the standards for a 'C' and a 'B' rating, the learner:

Rating 'B'
In addition to the standards for a 'C' rating, the learner:

Rating 'C'
The learner:

Rating A	Rating B	Rating C
elects appropriately to employ the average rate of change in context to solve problems	calculates and interprets the average rate of change from given information using appropriate units	calculates an average rate of change from given information using appropriate units
applies knowledge of the gradient of a function's tangent at various points to infer properties of the function	determines and relates the gradient of a function's tangent to the rate of change of the function	determines the gradient of a function's tangent with graphical scaffolding
differentiates polynomials in expanded form with rational powers	differentiates polynomials in expanded or in factored form	differentiates polynomials in expanded form
sketches a graph of the rate of change of a function whose graph is given	interprets the relationship between two variables by considering rates of change	uses a derivative to determine the instantaneous rate of change at a given value of the independent variable, with suitable units
uses a derivative to determine the equation of a normal to a curve at a point	uses a derivative to determine the equation of a tangent to a curve at a point	uses a derivative to determine the gradient to a curve at a point
examines the nature of the turning points of a given function and distinguishes between local and global extreme values, considering behaviours as $x \to \pm\infty$	finds, using calculus techniques, and interprets the local maxima and local minima of a given function	finds and interprets the local maxima and local minima of a given function using technology
constructs and interprets routine and non-routine displacement-time graphs, with velocity calculations	constructs and interprets routine displacement-time graphs, with velocity calculations	interprets displacement-time graphs
uses the first principles approach to determine the derivatives of simple quadratic functions.	uses the first principles approach to determine the derivative of x^n, for $n = 1, 2, 3$.	

* denotes criteria that are both internally and externally assessed

Criterion 8: understand experimental and theoretical probabilities and of statistics

This criterion is both internally and externally assessed.

Rating 'A'
In addition to the standards for a 'C' and a 'B' rating, the learner:

Rating 'B'
In addition to the standards for a 'C' rating, the learner:

Rating 'C'
The learner:

Rating A	Rating B	Rating C
		distinguishes between random selection and random events
designs and carries out simple probability experiments and simulations, recognising that randomness confers long-term order and predictability	designs and carries out simple probability experiments and simulations, identifying cases where inherent bias disrupts randomness	draws conclusions from experiments and simulations where relative frequencies provide point estimates of probabilities
calculates probabilities by constructing and using Venn diagrams and trees diagrams, where appropriate, in routine and non-routine problems	calculates probabilities by constructing Venn diagrams and tree diagrams in routine problems	calculates probabilities from data presented in lists, tables, Venn diagrams and tree diagrams
identifies situations where complementarity and mutually exclusivity apply	employs complementarity to simplify calculations, and mutually exclusivity to reduce the addition rule	distinguishes complementary and mutually exclusive events, and employs the addition rule for probability
identifies when conditional probability applies, including in more complex situations	applies the conditional probability formula $P(A \mid B) = \dfrac{n(A \cap B)}{n(B)}$ in straight-forward situations	interprets conditional probabilities in straight-forward situations
constructs diagrams that illustrate independent three-stage events and non-independent two-stage events to calculate probabilities	constructs diagrams that illustrate independent two-stage events to calculate probabilities	uses given diagrams that illustrate two stage events to calculate probabilities
determines the relevance of and calculates combinations in more complex situations.	uses the combination formula, ${}^{n}C_{r}$ or $\binom{n}{r}$, to determine probability in a straight-forward problems.	uses the combination formula, ${}^{n}C_{r}$ or $\binom{n}{r}$, to determine the number of possibilities in straight-forward combination problems.

* denotes criteria that are both internally and externally assessed

Qualifications Available

Mathematics Methods – Foundation Level 3 (with the award of):

EXCEPTIONAL ACHIEVEMENT

HIGH ACHIEVEMENT

COMMENDABLE ACHIEVEMENT

SATISFACTORY ACHIEVEMENT

PRELIMINARY ACHIEVEMENT

Award Requirements

The final award will be determined by the Office of Tasmanian Assessment, Standards and Certification from 13 ratings (8 from the internal assessment, 5 from the external assessment).

The minimum requirements for an award in Mathematics Methods – Foundation Level 3 are as follows:

EXCEPTIONAL ACHIEVEMENT (EA)
11 ‘A’ ratings, 2 ‘B’ ratings (4 ‘A’ ratings and 1 ‘B’ rating from external assessment)

HIGH ACHIEVEMENT (HA)
5 ‘A’ ratings, 5 ‘B’ ratings, 3 ‘C’ ratings (2 ‘A’ ratings, 2 ‘B’ ratings and 1 ‘C’ rating from external assessment)

COMMENDABLE ACHIEVEMENT (CA)
7 ‘B’ ratings, 5 ‘C’ ratings (2 ‘B’ ratings and 2 ‘C’ ratings from external assessment)

SATISFACTORY ACHIEVEMENT (SA)
11 ‘C’ ratings (3 ‘C’ ratings from external assessment)

PRELIMINARY ACHIEVEMENT (PA)
6 ‘C’ ratings

A learner who otherwise achieves the ratings for a CA (Commendable Achievement) or SA (Satisfactory Achievement) award but who fails to show any evidence of achievement in one or more criteria (‘z’ notation) will be issued with a PA (Preliminary Achievement) award.

Course Evaluation

The Department of Education’s Curriculum Services will develop and regularly revise the curriculum. This evaluation will be informed by the experience of the course’s implementation, delivery and assessment.

In addition, stakeholders may request Curriculum Services to review a particular aspect of an accredited course.

Requests for amendments to an accredited course will be forwarded by Curriculum Services to the Office of TASC for formal consideration.

Such requests for amendment will be considered in terms of the likely improvements to the outcomes for learners, possible consequences for delivery and assessment of the course, and alignment with Australian Curriculum materials.

A course is formally analysed prior to the expiry of its accreditation as part of the process to develop specifications to guide the development of any replacement course.

Course Developer

The Department of Education acknowledges the significant leadership of Gary Anderson, Sue Schaap and Lance Coad in the development of this course.

Expectations Defined By National Standards In Content Statements Developed by ACARA

The statements in this section, taken from documents endorsed by Education Ministers as the agreed and common base for course development, are to be used to define expectations for the meaning (nature, scope and level of demand) of relevant aspects of the sections in this document setting out course requirements, learning outcomes, the course content and standards in the assessment.

For the content areas of Mathematics Methods – Foundation, the proficiency strands – Understanding; Fluency; Problem Solving; and Reasoning – build on learners' learning in F-10 *Australian Curriculum: Mathematics*. Each of these proficiencies is essential, and all are mutually reinforcing. They are still very much applicable and should be inherent in the five areas of study.

MATHEMATICAL METHODS

Unit 1 – Topic 1: Functions and Graphs

Lines and linear relationships:

- examine examples of direct proportion and linearly related variables (ACMMM002)
- recognise features of the graph of $y = mx + c$ including its linear nature, its intercepts and its slope or gradient (ACMMM003)
- find the equation of a straight line given sufficient information; parallel and perpendicular lines (ACMMM004)
- solve linear equations. (ACMMM005)

Review of quadratic relationships:

- examine examples of quadratically related variables (ACMMM006)
- recognise 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 (ACMMM007)
- solve quadratic equations using the quadratic formula and by completing the square (ACMMM008)
- find the equation of a quadratic given sufficient information (ACMMM009)
- find turning points and zeros of quadratics and understand the role of the discriminant (ACMMM010)
- recognise features of the graph of the general quadratic $y = ax^2 + bx + c$. (ACMMM011)

Inverse proportion:

- examine examples of inverse proportion (ACMMM012)
- recognise features of the graph of $y = \frac{1}{x}$. (ACMMM013)

Powers and polynomials:

- recognise features of the graphs of $y = x^n$ for $n \in N$, $n = -1$ and $n = \frac{1}{2}$, including shape, and behaviour as $x \to \infty$ and $x \to -\infty$ (ACMMM014)
- identify the coefficients and the degree of a polynomial (ACMMM015)
- expand quadratic and cubic polynomials from factors (ACMMM016)
- recognise features 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 $x \to -\infty$ (ACMMM017)
- factorise cubic polynomials in cases where a linear factor is easily obtained (ACMMM018)
- solve cubic equations using technology, and algebraically in cases where a linear factor is easily obtained. (ACMMM019)

Graphs of relations:

- recognise features of the graphs of $y = x^n$ for $n \in N$, $n = -1$ and $n = \frac{1}{2}$, including shape, and behaviour as $x \to \infty$ and $x \to -\infty$ (ACMMM014)
- recognise features of the graphs of $x^2 + y^2 = r^2$ its centre and radius. (ACMMM020)

Functions:

- 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 (ACMMM022)
- use function notation, domain and range, independent and dependent variables (ACMMM023)
- understand the concept of the graph of a function(ACMMM024)
- examine translations and the graphs of $y = f(x) + a$and $y = f(x+b)$ (ACMMM025)
- examine dilations and the graphs of $y = cf(x)$ and $y = f(dx)$ (ACMMM026)
- recognise the distinction between functions and relations and the vertical line test. (ACMMM027)

Unit 1 – Topic 2: Trigonometric Functions

Cosine and sine rules:

- review sine, cosine and tangent as ratios of side lengths in right-angled triangles (ACMMM028)
- understand the unit circle definition of $\sin\theta$, $\cos\theta$ and $\tan\theta$, and periodicity using degrees (ACMMM029)
- examine the relationship between the angle of inclination of a line and the gradient of that line (ACMMM030)
- establish and use the sine and cosine rules. (ACMMM031)

Circular measure and radian measure:

- define and use radian measure and understand its relationship with degree measure (ACMMM032)
- calculate lengths of arcs and areas of sectors in circles. (ACMMM033)

Trigonometric functions:

- understand the unit circle definition of $\sin\theta$, $\cos\theta$ and $\tan\theta$, and periodicity using radians (ACMMM034)
- recognise the exact values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ at integer multiples of $\frac{\pi}{6}$ and $\frac{\pi}{4}$ (ACMMM035)
- recognise the graphs of $y=\sin x$, $y=\cos x$ and $y=\tan x$ on extended domains (ACMMM036)
- examine amplitude changes and the graphs of $y=a\sin x$ and $y=a\cos x$ (ACMMM037)
- examine period changes and the graphs of $y=\sin bx$, $y=\cos bx$, and $y=\tan bx$. (ACMMM038)

Unit 1 – Topic 3: Counting and Probability

Combinations:

- understand the notion of a combination as an ordered set of r objects taken from a set of n distinct objects (ACMMM044)
- 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 (ACMMM045)
- expand $(x+y)^n$ for small positive integers n (ACMMM046)
- recognise the numbers $\binom{n}{r}$ as binomial coefficients, (as coefficients in the expansion of $(x+y)^n$) (ACMMM047)
- use Pascal's triangle and its properties. (ACMMM048)

Language of events and sets:

- review the concepts and language of outcomes, sample spaces and events as sets of outcomes (ACMMM049)
- use set language and notation for events, including $\overline{A}$ (or $A\prime$) for the complement of an event A, $A\cap B$ for the intersection of events A and B, and $A\cup B$ for the union and recognise mutually exclusive events (ACMMM050)
- use everyday occurrences to illustrate set descriptions and representations of events, and set operations. (ACMMM051)

Review of the fundamentals of probability:

- review probability as a measure of 'the likelihood of occurrence' of an event (ACMMM052)
- review the probability scale: $0\leq P(A)\leq 1$ for each event A, with $P(A)=0$ if A is an impossibility, and $P(A)=1$ if A is a certainty (ACMMM053)
- review the rules: $P\left(\overline{A}\right)=1-P(A)$ and $P(A\cup B)=P(A)+P(B)-P(A\cap B)$ (ACMMM054)
- use relative frequencies obtained from data as point estimates of probabilities. (ACMMM055)

Conditional probability and independence:

- understand the notion of a conditional probability and recognise and use language that indicates conditionality (ACMMM056)
- use the notation $P(A\mid B)$ and the formula $P(A\cap B)=P(A\mid B).\,P(B)$ (ACMMM057)
- understand the notion of independence of an event A from an event B, as defined by $P(A\mid B)=P(A)$ (ACMMM058)
- 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 (ACMMM059)
- use relative frequencies obtained from data as point estimates of conditional probabilities and as indications of possible independence of events. (ACMMM060)

Unit 2 – Topic 1: Exponential Functions

Indices and the index laws:

- review indices (including fractional indices) and the index laws (ACMMM061)
- use radicals and convert to and from fractional indices (ACMMM062)
- understand and use scientific notation and significant figures. (ACMMM063)

Exponential functions:

- establish and use the algebraic properties of exponential functions (ACMMM064)
- recognise the qualitative features of the graph of $y = a^x$ ($a > 0$) including asymptotes, and of its translations ($y = a^x + b$ and $y = a^{x+c}$) (ACMMM065)
- identify contexts suitable for modelling by exponential functions and use them to solve practical problems (ACMMM066)
- solve equations involving exponential functions using technology and algebraically in simple cases. (ACMMM067)

Unit 2 – Topic 3: Introduction to Differential Calculus

Rates of change:

- interpret the difference quotient $\dfrac{f(x+h)-f(x)}{h}$ as the average rate of change of a function f (ACMMM077)
- use the Leibniz notation δx and δy for changes or increments in the variables x and y (ACMMM078)
- use the notation $\dfrac{\delta y}{\delta x}$ for the difference quotient $\dfrac{f(x+h)-f(x)}{h}$ where $y = f(x)$ (ACMMM079)
- interpret the ratios $\dfrac{f(x+h)-f(x)}{h}$ and $\dfrac{\delta y}{\delta x}$ as the slope or gradient of a chord or secant of the graph of $y = f(x)$. (ACMMM080)

The concept of the derivative:

- examine the behaviour of the difference quotient $\dfrac{f(x+h)-f(x)}{h}$ as $h \to 0$ as an informal introduction to the concept of a limit (ACMMM081)
- define the derivative $f\prime(x)$ as $\lim\limits_{h \to 0} \dfrac{f(x+h)-f(x)}{h}$ (ACMMM082)
- use the Leibniz notation for the derivative $\dfrac{dy}{dx} = \lim\limits_{\delta x \to 0} \dfrac{\delta y}{\delta x}$, and the correspondence $\dfrac{dy}{dx} = f\prime(x)$ where $y = f(x)$ (ACMMM083)
- interpret the derivative as the instantaneous rate of change (ACMMM084)
- nterpret the derivative as the slope or gradient of a tangent line of the graph of $y = f(x)$. (ACMMM085)

Computation of derivatives:

- estimate numerically the value of a derivative, for simple power functions (ACMMM086)
- examine examples of variable rates of change of non-linear functions (ACMMM087)
- establish the formula $\dfrac{d}{dx}(x^n) = nx^{n-1}$ for positive integers n by expanding $(x+h)^n$ or by factorising $(x+h)^n - x^n$. (ACMMM088)

Properties of derivatives:

- understand the concept of the derivative as a function (ACMMM089)
- recognise and use linearity properties of the derivative (ACMMM090)
- calculate derivatives of polynomials and other linear combinations of power functions. (ACMMM091)

Applications of derivatives:

- find instantaneous rates of change (ACMMM092)
- find the slope of a tangent and the equation of the tangent (ACMMM093)
- construct and interpret position - time graphs, with velocity as the slope of the tangent (ACMMM094)
- sketch curves associated with simple polynomials; find stationary points, and local and global maxima and minima; and examine behaviour as $x \to \infty$ and $x \to -\infty$ (ACMMM095)
- solve optimisation problems arising in a variety of contexts involving simple polynomials on finite interval domains. (ACMMM096)

Unit 4 – Topic 1: The Logarithmic Function

Logarithmic functions:

- define logarithms as indices $a^x = b$ is equivalent to $x = \log_a b$, i.e. $a^{\log_a b} = b$ (ACMMM151)
- establish and use the algebraic properties of logarithms (ACMMM152)
- recognise the inverse relationship between logarithms and exponentials: $y = a^x$ is equivalent to $x = \log_a y$ (ACMMM153)
- solve equations involving indices using logarithms (ACMMM155)
- recognise the qualitative features of the graph of $y = \log_a x$ ($a > 1$) including asymptotes, and of its translations $y = \log_a x + b$ and $y = \log_a (x + c)$ (ACMMM156)
- solve simple equations involving logarithmic functions algebraically and graphically. (ACMMM157)

Accreditation

The accreditation period for this course has been renewed from 1 January 2019 until 31 December 2021.

During the accreditation period required amendments can be considered via established processes.

Should outcomes of the Years 9-12 Review process find this course unsuitable for inclusion in the Tasmanian senior secondary curriculum, its accreditation may be cancelled. Any such cancellation would not occur during an academic year.

Version History

Version 1 – Accredited on 17 August 2016 for use from 1 January 2017. This course replaces Mathematics Methods – Foundation (MTM215116) that expired on 31 December 2016.

Version 1.1 – Renewal of accreditation on 13 August 2017 for use in 2018.

Version 1.1.a – Change of sub-heading 'Exponential and Logarithmic Functions' to 'Indices' and move of three content points from that place to 'Logarithmic functions'. 22 December 2017.

Accreditation renewed on 22 November 2018 for the period 1 January 2019 until 31 December 2021.

Accreditation renewed on 14 July 2021 for the period 1 January 2022 until 31 December 2023.

Appendix 1

GLOSSARY

Algebraic properties of exponential functions

The algebraic properties of exponential functions are the index laws: $a^x a^y = a^{x+y}$, $a^{-x} = \frac{1}{a^x}$, $(a^x)^y = a^{xy}$, $a^0 = 1$, where x, y and a are real.

Algebraic properties of logarithms

The algebraic properties of logarithms are the rules: $\log_a(xy) = \log_a x + \log_a y$, $\log_a\left(\frac{1}{x}\right) = -\log_a x$, and $\log_a 1 = 0$, for any positive real numbers x, y and a.

Asymptote

A straight line is an asymptote of the function $y = f(x)$ if graph of $y = f(x)$ gets arbitrarily close to the straight line. An asymptote can be horizontal, vertical or oblique. For example, the line with equation $x = \frac{\pi}{2}$ is a vertical asymptote to the graph of $y = \tan x$, and the line with equation $y = 0$ is a horizontal asymptote to the graph of $y = \frac{1}{x}$.

Binomial distribution

The expansion $(x+y)^n = x^n + \binom{n}{1}x^{n-1}y + \ldots + \binom{n}{r}x^{n-r}y^r + \ldots + y^n$ is known as the binomial theorem. The numbers $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n \times (n-1) \times \ldots \times (n-r+1)}{r \times (r-1) \times \ldots \times 2 \times 1}$ are called binomial coefficients.

Cartesian plane

The Cartesian plane is a plane consisting of a set of two lines intersecting each other at right angles. The horizontal line is the x-axis and the vertical one is the y-axis, and the point of their intersection is called the origin with the coordinates $(0, 0)$.

Circular measure

A rotation, typically measured in radians or degrees.

Completing the square

The quadratic expression $ax^2 + bx + c$ can be rewritten as $a\left(x + \frac{b}{2a}\right)^2 + \left(c - \frac{b^2}{4a}\right)$. Rewriting it in this way is called completing the square.

Conditional probability

The probability of an event A occurring when it is known that some event B has already occurred, is given by $P(A \mid B) = \frac{P(A \cap B)}{P(B)}$.

Discriminant

The discriminant (Δ) of the quadratic expression $ax^2 + bx + c$ is the quantity $b^2 - 4ac$.

Function

A function f is a rule such that for each x-value there is only one corresponding y-value. This means that if (a, b) and (a, c) are ordered pairs, then $b = c$.

Gradient (Slope)

The gradient of the straight line passing through points (x_1, y_1) and (x_2, y_2) is the ratio $\frac{y_2 - y_1}{x_2 - x_1}$. Slope is a synonym for gradient.

Graph of a function

The graph of a function f is the set of all points (x, y) in the Cartesian plane where x is in the domain of f and $y = f(x)$.

Independent events

Two events are independent if knowing that one occurs tells us nothing about the other. The concept can be defined formally using probabilities in various ways: events A and B are independent if $P(A \cap B) = P(A)P(B)$, if $P(A \mid B) = P(A)$ or if $P(B) = P(B \mid A)$. For events A and B with non-zero probabilities, any one of these equations implies any other.

Index laws

The index laws are the rules: $a^x a^y = a^{x+y}$, $a^{-x} = \frac{1}{a^x}$, $(a^x)^y = a^{xy}$, $a^0 = 1$, and $(ab)^x = a^x b^x$, where a, b, x and y are real numbers.

Length of an arc
The length of an arc of a circle is given by $l = r\theta$, where l is the arc length, r is the radius and θ is the angle subtended at the centre, measured in radians. This is simply a rearrangement of the formula defining the radian measure of an angle.

Linearity property of the derivative
The linearity property of the derivative is summarized by the equations:
$\frac{d}{dx}(ky) = k\frac{dy}{dx}$ for any constant k, and $\frac{d}{dx}(y_1 + y_2) = \frac{dy_1}{dx} + \frac{dy_2}{dx}$.

Local and global maximum and minimum
A stationary point on the graph $y = f(x)$ of a differentiable function is a point where $f\prime(x) = 0$.
We say that $f(x_0)$ is a *local maximum* of the function $f(x)$ if $f(x) \leq f(x_0)$ for all values of x near x_0.
We say that $f(x_0)$ is a *global maximum* of the function $f(x)$ if $f(x) \leq f(x_0)$ for all values of x in the domain of f.
We say that $f(x_0)$ is a *local minimum* of the function $f(x)$ if $f(x) \geq f(x_0)$ for all values of x near x_0.
We say that $f(x_0)$ is a *global minimum* of the function $f(x)$ if $f(x) \geq f(x_0)$ for all values of x in the domain of f.

Mutually exclusive
Two events are mutually exclusive if there is no outcome in which both events occur.

Non-routine problems
Problems solved using procedures not regularly encountered in learning activities.

Pascal's triangle
Pascal's triangle is a triangular arrangement of binomial coefficients. The n^{th} row consists of the binomial coefficients $\binom{n}{r}$, for $0 \leq r \leq n$; each interior entry is the sum of the two entries above it, and the sum of the entries in the n^{th} row is 2^n.

Period of a function
The period of a function $f(x)$ is the smallest positive number p with the property that $f(x+p) = f(x)$ for all x. The functions $\sin x$ and $\cos x$ both have period 2π, and $\tan x$ has period π.

Point of inflection
A point on a curve at which the curve changes from being concave (concave downward) to convex (concave upward), or vice versa.

Quadratic formula
If $ax^2 + bx + c = 0$ with $a \neq 0$, then $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. This formula for the roots is called the quadratic formula.

Radian measure
The radian measure θ of an angle in a sector of a circle is defined by $\theta = \frac{l}{r}$, where r is the radius and l is the arc length. Thus an angle whose degree measure is $180°$ has radian measure of π.

Random variable
A *random* variable is a numerical quantity, the value of which depends on the outcome of a chance experiment. For example, the proportion of heads observed in 100 tosses of a coin.
A *discrete* random variable is one which can only take a countable number of value, usually whole numbers.
A *continuous* random variable is one whose set of possible values are all of the real numbers in some interval.

Relative frequency
If an event E occurs r times in n trials of a chance experiment, the relative frequency of E is $\frac{r}{n}$.

Routine problems
Problems solved using procedures regularly encountered in learning activities.

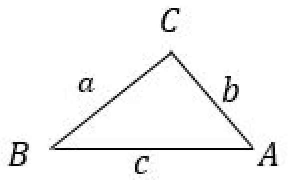
Secant
A secant of the graph of a function is a straight line passing through two points on the graph. The line segment between the two points is called a *chord*.

Sine and cosine functions
In the unit circle definition of $\mathbf{cosine}$ and $\mathbf{sine}$, $\cos\theta$ and $\sin\theta$ are the x- and y-coordinates of the point on the unit circle corresponding to the angle θ measured as a rotation from the ray OX. If θ is measured in the counter-clockwise direction, then it is said to be positive; otherwise it is said to be negative.

Sine rule and cosine rule

The lengths of the sides of a triangle are related to the sines of its angles by the equations

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$



This is known as the ***sine rule***.

The lengths of the sides of a triangle are related to the cosine of one of its angles by the equation
$c^2 = a^2 + b^2 - 2ab\cos C$

This is known as the ***cosine rule***.

Tangent line

The tangent line (or simply the *tangent*) to a curve at a given point P can be described intuitively as the straight line that has the same gradient at a curve where they meet. In this sense it is the best straight-line approximation to the curve at the point P.

Vertical line test

A relation between two real variables x and y is a function, and $y = f(x)$ for some function f, if and only if each vertical line, i.e. each line parallel to the y-axis, intersects the graph of the relation in at most one point. This test to determine whether a relation is, in fact, a function is known as the vertical line test.

Appendix 2

LINE OF SIGHT: Mathematics Method – Foundation Level 3

Learning Outcomes	**Separating out content from skills in 4 of LOs**		**Criteria and Elements**	**Content**
explain key concepts and techniques used in solving problems	algebra	key concepts problem solving interpret and evaluate select and use appropriate technology/tools	C4 E1-10 C4 E1-10 C4 E2, 3, 6, 10 C2 E1, 5	Algebra
solve problems using algebra, functions, graphs, calculus, probability and statistics	polynomial functions and graphs	key concepts problem solving interpret and evaluate select and use appropriate technology/tools	C5 E1-8 C5 E1-8 C5 E5-8 C2 E1, 5	Polynomial functions and graphs
interpret and evaluate mathematical information and ascertain the reasonableness of solutions to problems	exponential, logarithmic and circular functions	key concepts problem solving interpret and evaluate select and use appropriate technology/tools	C6 E1-9 C6 E1-9 C6 E3, 7, 8, 9 C2 E1, 5 C6 9	Exponential, logarithmic and circular functions
choose when or when not to use technology when solving problems	calculus	key concepts problem solving interpret and evaluate select and use appropriate technology/tools	C7 E1-8 C7 E1-8 C7 E6, 7 C2 E1, 5	Calculus
	probability and statistics	key concepts problem solving interpret and evaluate select and use appropriate technology/tools	C8 E1-7 C8 E1-7 C8 E6, 7 C2 E1, 5 C7 E7	Probability and Statistics
communicate their arguments and strategies when solving problems			C1 E1-7	All content areas
apply reasoning skills in the context of algebra, functions, graphs, calculus, probability and statistics			C2 E1-6	All content areas
organise and undertake activities including practical tasks			C3 E1-6	All content areas

Supporting documents including external assessment material

- Use Of Calculator Policy 2017.pdf (2017-07-25 03:43pm AEST)
- MTM315117 Exam Paper 2017.pdf (2017-11-23 04:54pm AEDT)
- MTM315117 Assessment Report 2017.pdf (2018-02-28 03:55pm AEDT)
- MTM315117 Exam Solutions 2017.pdf (2018-05-31 04:20pm AEST)
- MTM315117 TASC Exam Paper 2018.pdf (2018-11-22 12:16pm AEDT)
- MTM315117 - Assessment Panel Report 2018 and Solutions.pdf (2019-03-05 01:05pm AEDT)
- MTM315117 Mathematics Methods - Foundations TASC Exam Paper 2019.pdf (2019-11-20 04:52pm AEDT)
- MTM315117 Assessment Report 2019.pdf (2020-02-05 01:24pm AEDT)
- MTM315117 Mathematics Methods Foundation TASC Exam Paper 2020.pdf (2020-11-18 07:14pm AEDT)
- MTM315117 Assessment Report 2020.pdf (2021-01-18 03:20pm AEDT)
- MTM315117 Information Sheet.pdf (2021-04-19 12:28pm AEST)
- MTM315117 External Exam Specifications.pdf (2021-04-19 12:28pm AEST)
- MTM315117 Mathematics Methods Foundation TASC Exam Paper 2021.pdf (2021-11-13 12:27pm AEDT)

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