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Programme and Course Outline 2022
Year 11 Mathematics: Specialist Unit 1 & 2
Note: This outline is subject to change!

The program you have been issued references all objectives in the Australian Curriculum. The syllabus may be easily downloaded from the Schools Curriculum and Standards Authority (SCASA) website at (http://www.scsa.wa.edu.au/).

UNIT Name of course: Mathematics Specialist

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. Statistics are concerned with collecting, analysing, modelling and interpreting data in order to investigate and understand real world phenomena and solve problems in context. Together, mathematics and statistics provide a framework for thinking and a means of communication that is powerful, logical, concise and precise.
- Both mathematics and statistics are widely applicable as models of the world around us and there is ample opportunity for problem-solving throughout the Mathematics Specialist ATAR course. There is also a sound logical basis to this subject, and in mastering the course, students will develop logical reasoning skills to a high level.
- The Mathematics Specialist ATAR course provides opportunities, beyond those presented in the Mathematics Methods ATAR course, to develop rigorous mathematical arguments and proofs and to use mathematical and statistical models more extensively. Topics are developed systematically and lay the foundations for future studies in quantitative subjects in a coherent and structured fashion. Students of the Mathematics Specialist ATAR course will be able to appreciate the true nature of mathematics, its beauty and its functionality.
- The Mathematics Specialist ATAR course has been designed to be taken in conjunction with the Mathematical Methods ATAR course. The subject contains topics in functions, calculus, probability and statistics that build on and deepen the ideas presented in the Mathematical Methods ATAR course and demonstrate their application in many areas. Vectors, complex numbers and matrices are introduced. The Mathematics Specialist ATAR course is designed for students with a strong interest in mathematics, including those intending to study mathematics, statistics, all sciences and associated fields, economics or engineering at university.
- For all content areas of the Mathematics Specialist ATAR course, the proficiency strands of the Year 7–10 curriculum continue to be applicable and should be inherent in students' learning of the subject. These strands are Understanding, Fluency, Problem-solving and Reasoning and they are both essential and mutually reinforcing. For all content areas, practice allows students to achieve fluency of skills, such as finding the scalar product of two vectors, or finding the area of a region contained between curves, freeing up working memory for more complex aspects of problem-solving. In the Mathematics Specialist ATAR course, the formal explanation of reasoning through mathematical proof takes on an important role and the ability to present the solution of any problem in a logical and clear manner is of paramount importance. The ability to transfer skills learned to solve one class of problem, for example, integration, to solve another class of problem, such as in biology, kinematics or statistics, is a vital part of mathematics learning in this subject.
- The Mathematics Specialist ATAR course is structured over four units. The topics in Unit 1 broaden students' mathematical experience and provide different scenarios for incorporating mathematical arguments and problem solving. The unit blends algebraic and geometric thinking. In this subject, there is a progression of content, applications, level of sophistication and abstraction. For example, in Unit 1, vectors for two-dimensional space are introduced and in Unit 3, vectors are studied for three-dimensional space. The Unit 3 vector topic leads to the establishment of the equations of lines and planes, and this in turn prepares students for an introduction to solving simultaneous equations in three variables. The study of calculus, which is developed in the Mathematical Methods ATAR course, is applied in vectors in Unit 3 and applications of calculus and statistics in Unit 4.

Aims

- The Mathematics Specialist ATAR course aims to develop students':
- understanding of concepts and techniques drawn from combinatorics, geometry, trigonometry, complex numbers, vectors, matrices, calculus and statistics
- ability to solve applied problems using concepts and techniques drawn from combinatorics, geometry, trigonometry, complex numbers, vectors, matrices, calculus and statistics
- capacity to choose and use technology appropriately
- reasoning in mathematical and statistical contexts and interpretation of mathematical and statistical information, including ascertaining the reasonableness of solutions to problems
- capacity to communicate in a concise and systematic manner using appropriate mathematical and statistical language
- ability to construct proofs

Organisation

This course is organised into a Year 11 syllabus and a Year 12 syllabus. The cognitive complexity of the syllabus content increases from Year 11 to Year 12.

Structure of the syllabus

The Year 11 syllabus is divided into two units, each of one semester duration, which are typically delivered as a pair. The notional time for each unit is 55 class contact hours.

Organisation of content

Unit 1

Contains the three topics:
1.1 Combinatorics
1.2 Vectors in the plane
1.3 Geometry

The three topics in Unit 1 complement the content of the Mathematics Methods ATAR course. The proficiency strand of Reasoning, from the Year 7–10 curriculum, is continued explicitly in the topic Geometry through a discussion of developing mathematical arguments. This topic also provides the opportunity to summarise and extend students' studies in Euclidean Geometry, knowledge which is of great benefit in the later study of topics such as vectors and complex numbers. The topic Combinatorics provides techniques that are very useful in many areas of mathematics, including probability and algebra. The topic Vectors in the plane provides new perspectives on working with two-dimensional space and serves as an introduction to techniques which can be extended to three-dimensional space in Unit 3. These three topics considerably broaden students' mathematical experience and therefore begin an awakening to the breadth and utility of the subject. They also enable students to increase their mathematical flexibility and versatility.

Unit 2

Contains the three topics:
2.1 Trigonometry
2.2 Matrices
2.3 Real and complex numbers

In Unit 2, Matrices provide new perspectives for working with two-dimensional space and Real and complex numbers provides a continuation of the study of numbers. The topic Trigonometry contains techniques that are used in other topics in both this unit and Units 3 and 4. All topics develop students' ability to construct mathematical arguments. The technique of proof by the principle of mathematical induction is introduced in this unit.

Each unit includes:
a unit description – a short description of the focus of the unit
learning outcomes – a set of statements describing the learning expected as a result of studying the unit
unit content – the content to be taught and learned.

Role of technology

It is assumed that students studying the Mathematics Specialist ATAR course will have access to an extensive range of technological applications and techniques. If appropriately used, these have the potential to enhance the teaching and learning of mathematics. However, students also need to continue to develop skills that do not depend on technology. The ability to be able to choose when or when not to use some form of technology and to be able to work flexibly with technology are important skills in this course.

Representation of the general capabilities

The general capabilities encompass the knowledge, skills, behaviours and dispositions that will assist students to live and work successfully in the twenty-first century. Teachers may find opportunities to incorporate the capabilities into the teaching and learning program for Mathematics Specialist. The general capabilities are not assessed unless they are identified within the specified unit content.

Literacy

Literacy skills and strategies enable students to express, interpret, and communicate complex mathematical information, ideas and processes. Mathematics provides a specific and rich context for students to develop their ability to read, write, visualise and talk about complex situations involving a range of mathematical ideas. Students can apply and further develop their literacy skills and strategies by shifting between verbal, graphic, numerical and symbolic forms of representing problems in order to formulate, understand and solve problems and communicate results. This process of translation across different systems of representation is essential for complex mathematical reasoning and expression. Students learn to communicate their findings in different ways, using multiple systems of representation and data displays to illustrate the relationships they have observed or constructed.

Numeracy

Students who undertake this course will continue to develop their numeracy skills at a more sophisticated level, making decisions about the relevant mathematics to use, following through with calculations selecting appropriate methods and being confident of their results. This course contains topics that will equip students for the ever-increasing demands of the information age, developing the skills of critical evaluation of numerical information. Students will enhance their numerical operation skills by application in counting techniques problems, as well as in other topics such as the algebra of complex numbers, vectors, and with matrix arithmetic.

Information and communication technology capability

Students use information and communication technology (ICT) both to develop theoretical mathematical understanding and to apply mathematical knowledge to a range of problems. They use software aligned with areas of work and society with which they may be involved, such as for statistical analysis, generation of algorithms, manipulation and complex calculation. They use digital tools to make connections between mathematical theory, practice and application; for example, to use data, to address problems, and to operate systems in authentic situations.

Critical and creative thinking

Students compare predictions with observations when evaluating a theory. They check the extent to which their theory-based predictions match observations. They assess whether, if observations and predictions don't match, it is due to a flaw in theory or method of applying the theory to make predictions – or both. They revise, or reapply their theory more skilfully, recognising the importance of self-correction in the building of useful and accurate theories and making accurate predictions.

Personal and social capability

Students develop personal and social competence in mathematics through setting and monitoring personal and academic goals, taking initiative, building adaptability, communication, teamwork and decision making.

The elements of personal and social competence relevant to mathematics mainly include the application of mathematical skills for their decision making, life-long learning, citizenship and self-management. In addition, students will work collaboratively in teams and independently as part of their mathematical explorations and investigations.

Ethical understanding

Students develop Ethical understanding in mathematics through decision making connected with ethical dilemmas that arise when engaged in mathematical calculation and the dissemination of results, and the social responsibility associated with teamwork and attribution of input.

The areas relevant to mathematics include issues associated with ethical decision making as students work collaboratively in teams and independently as part of their mathematical explorations and investigations. Acknowledging errors rather than denying findings and/or evidence involves resilience and ethical understanding. Students develop increasingly advanced communication, research, and presentation skills to express viewpoints.

Intercultural understanding

Students understand mathematics as a socially constructed body of knowledge that uses universal symbols but has its origin in many cultures. Students understand that some languages make it easier to acquire mathematical knowledge than others. Students also understand that there are many culturally diverse forms of mathematical knowledge, including diverse relationships to number and that diverse cultural spatial abilities and understandings are shaped by a person’s environment and language.

Representation of the cross-curriculum priorities

The cross-curriculum priorities address contemporary issues which students face in a globalised world. Teachers will find opportunities to incorporate the priorities into the teaching and learning program for the Mathematics Specialist ATAR course. The cross-curriculum priorities are not assessed unless they are identified within the specified unit content.

Aboriginal and Torres Strait Islander histories and cultures

Mathematics courses value the histories, cultures, traditions and languages of Aboriginal and Torres Strait Islander Peoples’ past and ongoing contributions to contemporary Australian society and culture. Through the study of mathematics within relevant contexts, opportunities will allow for the development of students’ understanding and appreciation of the diversity of Aboriginal and Torres Strait Islander Peoples’ histories and cultures.

Asia and Australia's engagement with Asia

There are strong social, cultural and economic reasons for Australian students to engage with the countries of Asia and with the past and ongoing contributions made by the peoples of Asia in Australia. It is through the study of mathematics in an Asian context that students engage with Australia’s place in the region. By analysing relevant data, students have opportunities to further develop an understanding of the diverse nature of Asia’s environments and traditional and contemporary cultures.

Sustainability

Each of the mathematics courses provides the opportunity for the development of informed and reasoned points of view, discussion of issues, research and problem solving. Teachers are therefore encouraged to select contexts for discussion that are connected with sustainability. Through the analysis of data, students have the opportunity to research and discuss sustainability and learn the importance of respecting and valuing a wide range of world perspectives.

Units

Unit 1 begins with a review of the basic algebraic concepts and techniques required for a successful introduction to the study of functions and calculus. Simple relationships between variable quantities are reviewed, and these are used to introduce the key concepts of a function and its graph. The study of probability and statistics begins in this unit with a review of the fundamentals of probability, and the introduction of the concepts of conditional probability and independence. The study of the trigonometric functions begins with a consideration of the unit circle using degrees and the trigonometry of triangles and its application. Radian measure is introduced, and the graphs of the trigonometric functions are examined and their applications in a wide range of settings are explored.

In Unit 2, exponential functions are introduced and their properties and graphs examined. Arithmetic and geometric sequences and their applications are introduced and their recursive definitions applied. Rates and average rates of change are introduced, and this is followed by the key concept of the derivative as an ‘instantaneous rate of change’. These concepts are reinforced numerically (by calculating difference quotients), geometrically (as slopes of chords and tangents), and algebraically. This first calculus topic concludes with derivatives of polynomial functions, using simple applications of the derivative to sketch curves, calculate slopes and equations of tangents, determine instantaneous velocities, and solve optimisation problems.

In Unit 3, the study of calculus continues by introducing the derivatives of exponential and trigonometric functions and their applications, as well as some basic differentiation techniques and the concept of a second derivative, its meaning and applications. The aim is to demonstrate to students the beauty and power of calculus and the breadth of its applications. The unit includes integration, both as a process that reverses differentiation and as a way of calculating areas. The fundamental theorem of calculus as a link between differentiation and integration is emphasised. Discrete random variables are introduced, together with their uses in modelling random processes involving chance and variation. The purpose here is to develop a framework for statistical inference.

In Unit 4, the logarithmic function and its derivative are studied. Continuous random variables are introduced and their applications examined. Probabilities associated with continuous distributions are calculated using definite integrals. In this unit students are introduced to one of the most important parts of statistics, namely statistical inference, where the goal is to estimate an unknown parameter associated with a population using a sample of that population. In this unit, inference is restricted to estimating proportions in two-outcome populations. Students will already be familiar with many examples of these types of populations.

Unit 1

Week(s)	Essential Content	Syllabus Reference & Elaborations	Reference and Resources	Assessment
Term 1 1-2	**The nature of proof (Part 1)** Proofs involving numbers Rational and irrational numbers	[Notation for sets of numbers] 1.3.1 use implication, converse, equivalence, negation, inverse, contrapositive 1.3.2 use proof by contradiction 2.3.1 prove simple results involving numbers 2.3.2 express rational numbers as terminating or eventually recurring decimals and vice versa 2.3.3 prove irrationality by contradiction for numbers such as $\sqrt{2}$	Cambridge p43-44 Cambridge Ch 6A-C Cambridge Ch 2B *21CLD:* *Skilled communication* *Using technical language and logically structured writing*	
3-4	**Combinatorics** Permutations (ordered arrangements) The inclusion-exclusion principle for the union of two sets and three sets The pigeon-hole principle Combinations (unordered selections)	1.1.1 solve problems involving permutations 1.1.2 use the multiplication and addition principle 1.1.3 use factorial notation and 1.1.4 solve problems involving permutations involving restrictions with or without repeated objects 1.1.5 determine and use the formulas for finding the number of elements in the union of two and the union of three sets 1.1.6 solve problems and prove results using the pigeon-hole principle 1.1.7 solve problems involving combinations 1.1.8 use the notation $\binom{n}{r}$ or ${}^{n}C_{r}$ 1.1.9 derive and use associated simple identities associated with Pascal's triangle	Cambridge Ch 5	**Task 1 (Week 3)Fri** Test 1 The nature of proof & Counting Techniques 10%
5-10	**Vectors in the plane** Representing vectors in the plane by directed line segments Algebra of vectors in the plane	1.2.1 examine examples of vectors, including displacement and velocity 1.2.2 define and use the magnitude and direction of a vector 1.2.3 represent a scalar multiple of a vector 1.2.4 use the triangle and parallelogram rules to find the sum and difference of two vectors 1.2.5 use ordered pair notation and column vector notation to represent a vector 1.2.6 define unit vectors and the perpendicular unit vectors $\mathbf{i}$ and $\mathbf{j}$ 1.2.7 express a vector in component form using the unit vectors $\mathbf{i}$ and $\mathbf{j}$ 1.2.8 examine and use addition and subtraction of vectors in component form 1.2.9 define and use multiplication of a vector by a scalar in component form 1.2.10 define and use scalar (dot) product 1.2.11 apply the scalar product to vectors expressed in component form	AJ Sadler Ch 3 Cambridge Ch 17A-B AJ Sadler Ch 4 Cambridge Ch 17C	**Task 2 (Week8) Mon** Investigation 1 10%

		1.2.13 define and use projection of vectors 1.2.14 solve problems involving displacement, force and velocity involving the above concepts 1.2.12 examine properties of parallel and perpendicular vectors and determine if two vectors are parallel or perpendicular **End of Term 1**	Cambridge Ch 17C AJ Sadler Ch 6	
Term 2 1	Geometric vectors in the plane, including proof and use	1.3.16 the diagonals of a parallelogram intersect at right angles if, and only if, it is a rhombus 1.3.17 the midpoints of the sides of a quadrilateral join to form a parallelogram 1.3.18 the sum of the squares of the lengths of the diagonals of a parallelogram is equal to the sum of the squares of the lengths of the sides	Cambridge Ch 17E (note: 17F is not included in syllabus)	
2-3	**Geometry** Circle properties, including proof and use	1.3.6 an angle in a semicircle is a right angle 1.3.7 the size of the angle at the centre subtended by an arc of a circle is twice the size of the angle at the circumference subtended by the same arc 1.3.8 angles at the circumference of a circle subtended by the same arc are equal 1.3.9 the opposite angles of a cyclic quadrilateral are supplementary 1.3.10 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 1.3.11 the angle in the alternate segment theorem 1.3.12 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 1.3.13 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 length of the tangent equals the product of the lengths to the circle on the secant ($AM \times BM = TM^2$) 1.3.14 suitable converses of some of the above results 1.3.15 solve problems determining unknown angles and lengths and prove further results using the results listed above	Cambridge Ch 8 AJ Sadler Ch 5 *21CLD:* *Knowledge Construction & ICT for learning* *Using GeoGebra to discover and investigate circle theorems*	**Task 3 (Week 3)Fri** Test 2 Vectors 10%
4	**Exam Revision**	**Exam Revision**		
5-6	**Semester 1 Exam**	**Semester 1 Exam**		**Semester 1 Exam 18%**

Unit 2

Week(s)	Essential Content	Syllabus Reference & Elaborations	Reference and Resources	Assessment
7-9	**Exam Review** **The nature of proof (Part 2)** An introduction to proof by mathematical induction	1.3.3 use the symbols for implication (⇒), equivalence (⇔) 1.3.4 use the quantifiers 'for all' ∀ and 'there exists' ∃. 1.3.5 use examples and counter-examples 2.3.4 develop the nature of inductive proof, including the 'initial statement' and inductive step 2.3.5 prove results for sums, such as $1+4+9...+n^2=\frac{n(n+1)(2n+1)}{6}$ for any positive integer *n*. 2.3.6 prove divisibility results, such as $3^{2n+4}-3^{2n}$ is divisible by 5 for any positive integer *n*.	Cambridge Ch 6D-F *21CLD:* *Skilled communication* *Using technical language and logically structured writing to explain mathematical truth*	**Task 4 (Week 8) Mon** Test 3 10%
10	**Matrices** Matrix arithmetic	2.2.1 apply matrix definition and notation 2.2.2 define and use addition and subtraction of matrices, scalar multiplication, matrix multiplication, [multiplicative identity, and inverse] **End of Term 2**	Cambridge 15A-C	
Term 3 1	**Matrices** Matrix arithmetic Systems of Linear Equations	2.2.2 define and use [addition and subtraction of matrices, scalar multiplication, matrix multiplication,] multiplicative identity, and inverse 2.2.3 calculate the determinant and inverse of 2 × 2 matrices and solve matrix equations of the form $AX = B$, where A is a 2 × 2 matrix and X and B are column vectors 2.2.11 interpret the matrix form of a system of linear equations in two variables and use matrix algebra to solve a system of linear equations	Cambridge Ch 15D-E	**Task 5 (Week 1) Fri** Investigation 2 10%
2-3	Transformations in the plane	2.2.4 examine translations and their representation as column vectors 2.2.5 define and use basic linear transformations: dilations of the form $(x,y)\longrightarrow(\lambda_1 x, \lambda_2 y)$, rotations about the origin and reflection in a line that passes through the origin and the representations of these transformations by 2 × 2 matrices 2.2.6 apply these transformations to points in the plane and geometric objects 2.2.7 define and use composition of linear transformations and the corresponding matrix products 2.2.8 define and use inverses of linear transformations and the relationship with the matrix inverse 2.2.9 examine the relationship between the determinant and the effect of a linear transformation on area 2.2.10 establish geometric results by matrix multiplications; for example: show that the combined effect of 2 reflections is a rotation	Cambridge Ch 16A-E *21CLD:* *Knowledge Construction & ICT for Learning* *Using Desmos to discover and investigate transformation matrices* Cambridge Ch 16G	
4-6	**Trigonometry** The basic trigonometric functions	2.1.1 determine all solutions of $f(a(x-b))=c$ where f is one of sine, cosine or tangent 2.1.2 graph functions with rules of the form $y=f(a(x-b))+c$ where f is one of sine, cosine, or tangent	Cambridge Ch 10	

	Compound angles The reciprocal trigonometric functions, secant, cosecant and cotangent	2.1.3 prove and apply the angle sum, difference, and double angle identities 2.1.4 define the reciprocal trigonometric functions; sketch their graphs and graph simple transformations of them		
7-8	Trigonometric identities Applications of trigonometric functions to model periodic phenomena	2.1.5 prove and apply the Pythagorean identities 2.1.6 prove and apply the identities for products of sines and cosines expressed as sums and differences 2.1.7 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 $a\cos x + b\sin x = c$ 2.1.8 prove and apply other trigonometric identities such as $\cos 3x = 4\cos^3 x - 3\cos x$ 2.1.9 model periodic motion using sine and cosine functions and understand the relevance of the period and amplitude of these functions in the model	Cambridge Ch 11	
9-10	**Real and complex numbers** Complex numbers The complex plane	2.3.7 define the imaginary number i as a root of the equation $x^2 = -1$ 2.3.8 represent complex numbers in the rectangular form; $a + bi$ where a and b are the real and imaginary parts 2.3.9 determine and use complex conjugates 2.3.10 perform complex number arithmetic: addition, subtraction, multiplication and division 2.3.11 consider complex numbers as points in a plane, with real and imaginary parts, as Cartesian coordinates 2.3.12 examine addition of complex numbers as vector addition in the complex plane 2.3.13 develop and use the concept of complex conjugates and their location in the complex plane **End of Term 3**	Cambridge Ch 13A-C	**Task 6 (Week 10) Fri** Test 4 Matrices and Trigonometry 10%
Term 4 1	**Real and complex numbers (continued)** Roots of equations	2.3.14 use the general solution of real quadratic equations 2.3.15 determine complex conjugate solutions of real quadratic equations 2.3.16 determine linear factors of real quadratic polynomials	Cambridge Ch 13D	
2	**Exam Revision**	**Exam Revision**		
3-4	**Semester 2 Exam**	**Semester 2 Exam**		**Semester 2 Exam 22%**
5-8		Year 12 Specialist Course **End of Term 4**		

TEXT Cambridge Specialist Mathematics Year 11
Sadler "Mathematics Specialist Units 1 & 2"

WEBSITES SCASA www.scsa.wa.edu.au

Appendix – Grade descriptions Year 11

Grade	Description
A	**Identifies and organises relevant information** Identifies and organises relevant information from complex sources, for example descriptive passages, labelled diagrams or tables of data. Recognises various vector and trigonometric functions and their domain and range. Identifies key elements in ambiguous data, such as how the domain of an angle affects the sign of the trigonometric ratios. Identifies key information from scattered sources such as interpreting the physical contexts involving combinations or permutations and solving related problems.
	Chooses effective models and methods and carries the methods through correctly Chooses and uses the correct technique or model in unpractised situations. Carries deductive reasoning and extended responses through clearly. Simplifies complicated fractions and works efficiently with algebraic expressions in fraction form. Translates fluently between representations, such as geometric vector diagrams to algebraic expressions. Uses a calculator appropriately for calculation, algebra and graphing, and highlights less obvious features of graphs, such as asymptotes or end points.
	Follows mathematical conventions and attends to accuracy Uses correct notation with vectors, matrices, combinatorics and complex numbers. Defines variables and parameters to suit the context. Draws clear geometric and vector diagrams with appropriate scales and labels. Works well with exact values such as surds, radian values or factorial notation, and recognises the difference between open and closed intervals. Uses appropriate logical operators and geometric notation when setting out geometric proofs.
	Links mathematical results to data and contexts to reach reasonable conclusions Pays attention to units in all tasks, giving answers to the correct degree of accuracy, and uses radian measure when appropriate. Takes account of the domain with time as the independent variable defined in vector problems, or by the context of the question, and excludes any results outside the domain.
	Communicates mathematical reasoning, results and conclusions Shows the main steps in mathematical reasoning in a logical sequence. Sets out geometric proofs in a logical and clear manner. Draws diagrams and defines appropriate vertices and angles to use in the working of a problem. Relates the result of a problem to the context of the question by using the correct units and any related notation, such as vector notation.

Grade	Description
B	**Identifies and organises relevant information** Identifies and organises relevant information from concentrated or scattered sources. Draws and labels diagrams from written instructions. Identifies key elements in ambiguous data, for example distinguishing the time required as the time of day rather than the time elapsed.
	Chooses effective models and methods and carries the methods through correctly Carries deductive reasoning and extended responses through and applies various rules, for example the Distributive Law or Commutative Law to simplify vector dot products. Generalises mathematical structures when determining the transformational effects of the parameters *a*, *b*, *c* and *d*, in trigonometric equations, for example, $y=a\sin b(x+c)+d$. Moves between representations in unpractised ways, such as drawing vectors in the Cartesian plane to determine the resultant. Converts multi-dimensional units such as kilometres per hour to meters per second. Uses a calculator appropriately for vectors, geometry and graphing and pays attention to features of graphs, such as amplitude and phase shift. Carries through accurately with vector algebra.
	Follows mathematical conventions and attends to accuracy. Rounds to suit contexts, specified accuracies and boundary values on occasions, for example rounds 3.70 hours to 3 hours 42 minutes (i.e. to the nearest minute). Takes note of the laws used when dealing with matrix algebra. Interprets the information on diagrams by using the various geometric symbols such as parallel lines or congruent sides.
	Links mathematical results to data and contexts to reach reasonable conclusions Attends to units in extended tasks, such as determining the distance travelled in a set time given the vector equation of motion. Can switch logical statements, for example to their converse or contrapositive.
	Communicates mathematical reasoning, results and conclusions Shows main steps in reasoning when setting out a geometric proof. Identifies the period and scale factor of a tangent graph $y=a\tan bx$ from a given graph.
C	**Identifies and organises relevant information** Identifies and organises relevant information that is relatively narrow in scope, for example, uses the information in diagrams supplied with the problem. Identifies the correct trigonometric formulas in straightforward situations. Writes the component form of vectors from a Cartesian diagram.
	Chooses effective models and methods and carries the methods through correctly Answers structured questions that require short responses, such as solving simple vector diagrams or composing functions. Makes common sense connections in practical diagrams involving navigation or simple bearings. Translates between representations in practised ways, for example matches trigonometric graphs to their stated equation, draws vector diagrams on a Cartesian plane from a given simple component form. Uses a calculator appropriately for calculation, combinatorics or straightforward graphing. Shows basic features on sketches of graphs located using a calculator.

	Follows mathematical conventions and attends to accuracy Defines introduced variables, for example, labels a diagram and allocates a variable to the length of an unknown side or the size of angle. Applies conventions for diagrams and graphs by labelling points with upper case letters, for example A, B and using arrows to convey the direction of a vector. Rounds to suit contexts and specified accuracies in short responses, for example, rounding angles to the nearest degree in navigation problems.
	Links mathematical results to data and contexts to reach reasonable conclusions Recognises specified conditions in short responses and includes the SI units with an answer when required, for example, velocity (ms^{-1}) x time (s) = distance (m). Attends to radian measure or degrees as is appropriate in trigonometry problems.
	Communicates mathematical reasoning, results and conclusions Shows working and sets out algebraic solutions correctly in short response questions. Makes clear sketches of simple functions, including some detail. Draws simple diagrams to help with solving problems of space and measurement.

D	**Identifies and organises relevant information** Identifies and organises relevant information that is narrow in scope. Converts degrees to radians and vice versa.
	Chooses effective models and methods and carries the methods through correctly Answers familiar, structured questions that require short responses, for example locating the intersection of two graphs. Reads the components of vectors from a diagram. Applies mathematics in practised ways to calculate magnitude of vectors. Simplifies fractions such as $\frac{5\pi}{6}\times\frac{180^0}{\pi}$.
	Follows mathematical conventions and attends to accuracy Applies conventions for graphs to label axes, set up a scale, and label different graphs on the same axes with some errors. Rounds to suit contexts and specified accuracies in short responses, such as rounding to a stated degree of accuracy, for example x = 30.86 km (two decimal places).
	Links mathematical results to data and contexts to reach reasonable conclusions Does not recognise specified conditions to identify the need to give exact value answers with conversions of radian measure to degrees. Attends to units in short responses when prompted, for example, the unit measure when calculating the magnitude of a vector.
	Communicates mathematical reasoning, results and conclusions Uses correct vector notation most of the time. Expresses the component parts **i** and **j** of a vector during calculations and in manipulations of terms or expressions. Obeys conventions for vector diagrams. Labels simple geometry diagrams and expands combination and permutation expressions with some errors.

E	Does not meet the requirements of a D grade and/or has completed insufficient assessment tasks to be assigned a higher grade.