KIRWAN STATE HIGH SCHOOL	SUBJECT: SPECIALIST MATHEMATICS	UNIT: 1

Unit Description	Unit Objectives
In Unit 1, students will develop the mathematical understandings and skills to solve problems relating to the topics: • Topic 1: Combinatorics • Topic 2: Vectors in the plane • Topic 3: Introduction to proof. Combinatorics provides techniques that are useful in many areas of mathematics, including probability and algebra. Vectors in the plane provides new perspectives for working with two-dimensional space, and serves as an introduction to techniques that will extend to three-dimensional space in Unit 3. Introduction to proof provides the opportunity to summarise and extend students' studies in deductive Euclidean geometry, and is of great benefit in the study of other topics in the course, including vectors and complex numbers.	Students will: 1. select, recall and use facts, rules, definitions and procedures drawn from all Unit 1 topics 2. comprehend mathematical concepts and techniques drawn all Unit 1 topics 3. communicate using mathematical, statistical and everyday language and conventions 4. evaluate the reasonableness of solutions 5. justify procedures and decisions by explaining mathematical reasoning 6. solve problems by applying mathematical concepts and techniques drawn from all Unit 1 topics.

Assessment Plan:				
Task	**%**	**Objectives to be assessed**	**Conditions**	**Date**
IA1 – Internal Assessment 1 PSMT – *Unit 1 – Topic -2*	20	As above – all objectives included on assessment item	4 weeks – including 3 hours of class time	Term 1 Week 9
Task	**%**	**Objectives to be assessed**	**Conditions**	**Date**
IA2 – Internal Assessment 2 Examination – *representatively sample all Unit 1 topics not assessed by the PSMT*	15	As above – all objectives included on assessment item	Closed Book QCAA formula sheet required Technology Free Technology Active 120 minutes + 5 minutes perusal	Term 2 Week 5

Monitoring and Reviewing:			
Strategies for Monitoring Student Progress	**Date**	**Planned Reviews at Key Intervals**	**Date**
Student Summary Rule book – separate book following through all units Proficiency scales KNOW and be able to DO tables (KDT) Regular vocabulary review, HW – weekly review, Formative items Common mistakes recognition Use of online support – Education Perfect, Khan Academy, Text-based online support Graphic organisers – e.g. mind maps, Frayer model, KWL (what I know, what I want to know, what I have learnt)		10 minute review (weekly quiz) during one lesson a week Mathspace quizzes - weekly Formative items	Each week Week 5 Week 10

		Underpinning Factors:		
Guaranteed Vocabulary:	**Literacy Skills**			**21st Century Skill/s**
Topic 1 – Combinatorics addition principle, arrangement, permutation, combination, multiplication principle, mutually exclusive, pigeon hole ***Topic 2 – Vectors*** Cartesian form, component form, direction, displacement, displacement (or free) vector, dot product, equilibrium, magnitude, norm, orthogonal, perpendicular, polar form, position vector, projection vector, resolving a vector, resultant vector, scalar, unit vector, vector ***Topic 3 –Proofs*** contradiction, contrapositive, converse, counter-example, cyclic, equivalence, implication, negation, proof, proposition, secant, statement, subtended	***Topic 1 – Combinatorics*** **• using procedural vocabulary** - how many ways/arrangements - select objects with replacement - select objects without replacement - show - write down **• using conventions (symbols, abbreviations)** - $n!, {}^nP_r, {}^nP_r, \binom{n}{r}, n!, \forall, \in, Z$ **• oral** - articulating different arrangements with/without restrictions; distinction between the use of 'and' and 'or' statements - putting combinatorics into words **• visual** - using graphs, tables, grids, Venn diagrams	***Topic 2 – Vectors*** **•using procedural vocabulary** - determine the vector - find the vector - represent the vector - sketch the vector - state the vector **• using conventions (symbols, abbreviations)** - $\begin{bmatrix} x \\ y \end{bmatrix}, \overrightarrow{AB}, \underline{c}$ *and* $\boldsymbol{d}, \lvert\overrightarrow{AB}\rvert, \lvert\underline{C}\rvert$ *and* $\lvert\boldsymbol{d}\rvert$ **• oral** - articulating different ways vectors can be expressed in two dimensions **• visual** - using graphs, diagrams, scale pictures, Cartesian planes, vector diagrams modelling real-life situations, two- and three-dimensional perspectives	***Topic 3 –Proofs*** **• using procedural vocabulary** - find - develop - show - prove **• using conventions (symbols, abbreviations)** - $\Rightarrow, \Leftrightarrow, =, \neq, \forall, \exists, \neg$ **• oral articulating different methods of proof** – articulating symbols associated with proofs in this topic – discussing using logic – using contradictory and negation statements **• visual** – using tables, diagrams, vector diagrams, circle diagrams	• critical thinking – reasoning – problem-solving – decision-making • collaboration and teamwork – relating to others – participating and contributing • communication – using language, symbols & texts • creative thinking – making connections • ICT skills – accessing and analysing information – being productive users of technology

	Numeracy Skills			Cognitive Verbs
	Topic 1 – Combinatorics • calculating with whole numbers • recognising and using patterns and relationships • showing capacity to use mathematical knowledge in a range of contexts • using digital tools, diagrams spreadsheets, etc. • making informed decisions based on the expected returns in game theory	***Topic 2 – Vectors*** • calculating with irrational numbers • working with directions and bearings • recognising and using patterns and relationships • showing capacity to use mathematical knowledge in a range of contexts • using digital geometry tools, diagrams	***Topic 3 –Proofs*** • calculating • recognising and using patterns and relationships • showing capacity to use mathematical knowledge in a range of contexts • using tools — digital tools, tables etc. • making decisions and judgments with critical orientation	**Retrieval & Comprehension** ***Calculate*** – determine or find (e.g. a number, answer) by using mathematical processes; obtain a numerical answer showing the relevant stages in the working; ascertain/determine from given facts, figures or information ***Use*** - operate or put into effect; apply knowledge or rules to put theory into practice **Analytical Processes** ***Identify*** *(Errors/Problems)* – distinguish; locate, recognise and name; establish or indicate who or what someone or something is; provide an answer from a number of possibilities; recognise and state a distinguishing factor or feature ***Interpret*** - use knowledge and understanding to recognise trends and draw conclusions from given information; make clear or explicit; elucidate or understand in a particular way; give one's own interpretation of; identify or draw meaning from, or give meaning to, information presented in various forms, such as words, symbols, pictures or graphs **Knowledge Utilisation** ***Solve*** – find an answer to, explanation for, or means of dealing with (e.g. a problem); work out the answer or solution; obtain the answer/s using algebraic, numerical and/or graphical methods

TEACHING AND LEARNING PLAN:

Hours/ Weeks	Unit Objectives	Subject Matter	Learning Experiences [reflecting DQ 3, 4, 5 & 6]	Possible Resources
Unit 1 *Weeks 1-4* Term 1 Weeks 1-4 9 Hours	1,2,3,4,5,6	**Combinatorics** **Inclusion/Exclusion Principle (4 hours)** • determine and use the formulas (including the addition principle) for finding the number of elements in the union of two and the union of three sets • use the multiplication principle. **Permutations (ordered selections) (4 hours** • solve problems involving permutations • use factorial notation • use the notation ${}^{n}P_{r} = \frac{n!}{(n-r)!}$ • solve problems involving permutations with restrictions **Combinations (unordered selections) (5 hours)** • use the notation $\binom{n}{r}$ and ${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$ • derive and use simple identities associated with Pascal's triangle • solve problems involving combinations with restrictions • apply permutations and combinations to probability problems. **The pigeon-hole principle (2 hours)** • solve problems and prove results using the pigeon-hole principle.	Refer to QCAA TLAP - Specialist Mathematics **Review Combinatorics** **Reflection (Weeks 1–3)** • Introduce the use of a 'Summary (Rule) book' students use a separate exercise book from their day-to-day exercise book to summarise the main points of each sub-topic throughout the four-unit course. Summarise the main points learned. • Formative test • Examine examples of vectors	Textbook Maths Quest – Specialist Mathematics Units 1 & 2 Digital version also available
Unit 2 *Weeks 5-10* Term 1 Weeks 5 -10 15 Hours	1,2,3,4,5,6	**Vectors** ***Representing Vectors in the plane by directed line segments (6 hours)*** • examine examples of vectors • understand the difference between a scalar and a vector • define and use the magnitude and direction of a vector • understand and use vector equality • understand and use both the Cartesian form and polar form of a vector • represent a scalar multiple of a vector • use the triangle rule to find the sum and difference of two vectors. **Algebra of Vectors in the plane (11 hours)** • use ordered pair notation and column vector notation to represent a vector • understand and use vector notation: $\overrightarrow{AB}, \underline{c}, \boldsymbol{d}$, unit vector notation $\hat{\boldsymbol{n}}$ • convert between Cartesian form and polar form • determine a vector between two points • define and use unit vectors and the perpendicular unit vectors $\hat{\boldsymbol{\imath}}$ and $\hat{\boldsymbol{\jmath}}$ • express a vector in component form using the unit vectors $\hat{\boldsymbol{\imath}}$ and $\hat{\boldsymbol{\jmath}}$ • examine and use addition and subtraction of vectors in component form • define and use multiplication by a scalar of a vector in component form • define and use a vector representing the midpoint of a line segment • define and use scalar (dot) product	Refer to QCAA TLAP - Specialist Mathematics	

		• apply the scalar product to vectors expressed in component form • examine properties of parallel and perpendicular vectors and determine if two vectors are parallel or perpendicular • define and use projections of vectors • solve problems involving displacement, force, velocity, equilibrium and relative velocity involving the above concepts	***Review*** Reflection Formative 60min on topics 1 & 2	
Unit 1 Weeks 11-14 Term 2 Weeks 1-4 13 Hours	1,2,3,4,5,6	**Introduction to Proof** **The Nature of Proof (5 hours)** • use implication, converse, equivalence, negation, contrapositive • use proof by contradiction • use the symbols for implication (⇒), equivalence (⇔), and equality • use the quantifiers for all (∀) and there exists (∃) • use examples and counterexamples. **Rational & irrational numbers (4 hours)** • prove simple results involving numbers • express rational numbers as terminating or eventually recurring decimals and vice versa • prove irrationality by contradiction. **Circle properties and their proofs (8 hours)** • prove circle properties, such as: – an angle in a semicircle is a right angle – the angle at the centre subtended by an arc of a circle is twice the angle at the circumference subtended by the same arc – angles at the circumference of a circle subtended by the same arc are equal – the opposite angles of a cyclic quadrilateral are supplementary – chords of equal length subtend equal angles at the centre and conversely chords subtending equal angles at the centre of a circle have the same length – a tangent drawn to a circle is perpendicular to the radius at the point of contact – the alternate segment theorem – when two chords of a circle intersect, the product of the lengths of the intervals on one chord equals the product of the lengths of the intervals on the other chord and its converse – when a secant (meeting the circle at A and B) and a tangent (meeting the circle at T) are drawn to a circle from an external point M, the square of the length of the tangent equals th product of the lengths to the circle on the secant; ($AM \times BM = TM^2$) and its converse • solve problems finding unknown angles and lengths and prove further results using the circle properties listed above. **Geometric proofs using vectors (6 hours)** • prove the diagonals of a parallelogram meet at right angles if and only if it is a rhombus. • prove midpoints of the sides of a quadrilateral join to form a parallelogram. • prove the sum of the squares of the lengths of a parallelogram's diagonals is equal to the sum of the squares of the lengths of the sides. • prove an angle in a semicircle is a right angle.	Refer to QCAA TLAP - Specialist Mathematics ***Review & Assessment*** Review IA2 – 2x60min exam in class time + 2x2.5mins of perusal	