12 F Maths	Term 1	Term 2	Term 3	Term 4	Term 5	Term 6
Theme/Big Idea	Developing Advanced Mathematical Structures, Representations and Algorithms for Analytical Problem Solving	Developing Advanced Algebraic Structures and Network Optimisation for Mathematical Modelling and Problem Solving	Developing Mathematical Modelling, Optimisation and Transformation through Advanced Algebra and Networks	Developing Mathematical Rigour, Advanced Modelling and Optimisation for Sophisticated Problem Solving	Developing Advanced Spatial Reasoning and Project Optimisation for Mathematical Modelling and Decision Making	Developing Advanced Mathematical Structures and Optimisation Techniques for Solving Complex Problems
Content What are they learning? (including keywords)	**1CP1** Students develop understanding of imaginary and complex numbers, performing calculations and solving polynomial equations with complex roots. They investigate how root structures, including conjugate pairs, are reflected within algebraic equations. **1CP2** Students represent complex numbers on Argand diagrams, exploring modulus and argument forms. They investigate loci, regions and geometric relationships, linking algebraic and	**1CP4** Students investigate relationships between polynomial coefficients and roots, solving equations and generalising results for higher powers. They apply transformations to roots to form and analyse related equations. **1CP6** Students develop understanding of matrix operations, determinants and inverses. They solve systems of linear equations and interpret solutions geometrically through	**1CP6** Completion of content started in Term 2. **1CP7** Students use matrices to represent and analyse transformations in two and three dimensions, including rotations, reflections, enlargements and stretches. They investigate successive transformations and explore how determinants describe area scale factors and geometric change. **D1-5** Students investigate classical and practical travelling salesman problems, applying	**1CP8** Students develop rigorous proof techniques using mathematical induction. They prove formulae, divisibility results, matrix relationships and recurrence relations, strengthening logical reasoning and mathematical communication. **1CP5** Students apply integration to find volumes generated by rotating functions about coordinate axes. They investigate composite solids formed between curves and piecewise-defined functions.	**1CP9 (part 2)** Students extend vector methods using scalar and vector products to analyse three-dimensional geometry. They calculate angles, intersections and perpendiculars, and use vector techniques to determine minimum distances between points, lines and planes. **D1-8** Students develop project modelling techniques using critical path analysis. They investigate precedence, dependence, floats and dummy activities, applying scheduling methods and Gantt	**2CP1** Students extend complex number methods using exponential form and De Moivre's Theorem to simplify calculations, form identities and solve equations. They find roots of complex numbers and apply these techniques to solve equations and geometric problems, and work with series. **D2-1** Students develop optimisation techniques for transportation problems, using the North-West Corner and Stepping-Stone methods. They balance supply and demand

	graphical representations of complex numbers. **1CP3** Students use sigma notation to represent and evaluate series. They apply standard summation formulae to simplify expressions and solve problems involving polynomial sequences and series. **D1-1** Students investigate algorithms and flow diagrams, learning and applying sorting methods. They analyse algorithm efficiency and consider how problem size affects completion time. **D1-2** Students develop understanding of graphs and networks using precise mathematical language. They explore matrix representations, analyse network structures and apply planarity algorithms to determine whether networks can be drawn without crossings.	intersections of planes in three dimensions. **D1-3** Students apply Kruskal's, Prim's, Dijkstra's and Floyd's algorithms to directed and undirected networks, identifying efficient routes and optimising solutions in increasingly complex situations. **D1-4** Students investigate Eulerian graphs and traversability. They apply the route inspection (Chinese Postman) algorithm to determine efficient routes through networks, including those with multiple odd nodes. **Key vocabulary listed in Appendix 1**	network theory to identify efficient routes. They use minimum spanning trees and nearest neighbour algorithms to establish bounds and evaluate optimal solutions. **D1-6** Students formulate real-world situations as linear programming problems. They represent constraints graphically, identify feasible regions and determine optimal solutions using objective lines, vertex testing and integer programming techniques. **Key vocabulary listed in Appendix 1**	**1CP9 (part 1)** Students use vectors to describe direction and position in three-dimensional space. They develop equations of lines and planes in both vector and Cartesian forms and explore their geometric relationships. **D1-7** Students extend linear programming through slack and surplus variables, Simplex tableaux, integer solutions and advanced methods including the Two-Stage Simplex and Big-M algorithms for optimisation. **Key vocabulary listed in Appendix 1**	charts to optimise project completion whilst considering resource constraints. **Key vocabulary listed in Appendix 1**	using dummy nodes and improve solutions using shadow costs to minimise distribution and logistics costs. **Key vocabulary listed in Appendix 1**

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Skills How are they learning it?	Apply mathematical reasoning to represent and manipulate complex numbers in algebraic, graphical and geometric forms. Use mathematical thinking to identify patterns and structures within polynomial equations, series and summations. Apply algorithmic thinking to interpret and evaluate processes, considering efficiency and computational complexity. Use graph-theoretic reasoning to model, analyse and represent networks using a range of mathematical methods.	Apply algebraic thinking to identify relationships between polynomial roots and coefficients, and generalise mathematical results. Use matrix methods to represent, analyse and solve systems of equations and geometric relationships. Apply algorithmic reasoning to optimise routes and solve shortest-path problems within networks. Use graph theory to analyse traversability, connectivity and efficiency in complex network structures.	Apply matrix methods to represent and analyse geometric transformations in two and three dimensions. Use mathematical reasoning to interpret determinants and their relationship to geometric scaling and transformation. Apply network algorithms to optimise routes, evaluate solutions and compare competing strategies. Use mathematical modelling to formulate and solve optimisation problems using linear programming techniques.	Apply rigorous mathematical reasoning to construct and communicate formal proofs using mathematical induction. Use advanced integration techniques to model and calculate volumes of complex three-dimensional shapes. Apply vector methods to represent and analyse lines, planes and geometric relationships in three dimensions. Use optimisation techniques, including Simplex methods, to solve increasingly sophisticated linear programming problems.	Apply vector reasoning to analyse geometric relationships, angles, intersections and distances in three-dimensional space. Use mathematical thinking to interpret and solve complex spatial problems involving lines, planes and perpendicular distances. Apply network modelling techniques to represent, analyse and optimise project schedules. Use mathematical reasoning to evaluate dependencies, critical paths and resource allocation within project planning.	Apply complex number techniques using exponential form and De Moivre's Theorem to solve algebraic and geometric problems. Use mathematical reasoning to analyse roots of complex numbers and identify patterns within series and identities. Apply optimisation algorithms to transportation and distribution problems, evaluating and improving solutions systematically. Use network modelling techniques to balance constraints and minimise costs in real-world logistical situations.
Key Questions	**What** advantages do complex numbers provide, **how** do modulus, argument and Argand diagrams reveal the structure of complex numbers, and **how** can they be used	**What** relationships exist between polynomial roots and coefficients, **why** are they important, and **how** can they be used to solve and construct equations?	**How** can matrices be used to represent transformations, **why** are determinants important, and **what** do they reveal about geometric change?	**What** makes a mathematical proof rigorous, **why** is induction a powerful proof technique, and **how** can it be used to establish general results?	**What** do scalar and vector products reveal about geometric relationships, **why** are they important, and **how** can they be used to solve three-dimensional problems?	**What** advantages does the exponential form of a complex number provide, **why** is De Moivre's Theorem important, and **how** can these ideas be

	to describe loci and regions? **What** patterns exist within sequences and series, **why** is sigma notation useful, and **how** can summation formulae help us solve problems efficiently? **What** makes an algorithm efficient, **why** does efficiency matter as problem size grows, and **how** can sorting methods be compared? **How** can graphs, networks and matrix representations model complex relationships, **why** are these models important, and **how** can they be analysed mathematically?	**How** do matrices represent mathematical information, **why** are determinants and inverses important, and **how** can they be used to solve systems of equations? **What** makes a network algorithm efficient, **why** do different algorithms suit different problems, and **how** can they optimise routes and connections? **What** determines whether a graph is traversable, **why** are Eulerian properties important, and **how** can route inspection algorithms find efficient solutions?	**What** makes a route optimal, **why** are exact solutions not always practical, and **how** can network algorithms help us find efficient solutions? **How** can real-world constraints be represented mathematically, **why** is optimisation important, and **how** can linear programming identify the best solution? **What** links transformations, networks and optimisation problems, **why** are mathematical models useful, and **how** do they support decision-making?	**How** can integration be used to determine volumes of revolution, **why** is this extension of area important, and **how** can it model complex solids? **What** advantages do vector equations of lines and planes provide, **why** are multiple representations useful, and **how** can they describe three-dimensional relationships? **How** can optimisation problems be modelled mathematically, **why** are advanced Simplex methods needed, and **how** can they identify optimal solutions efficiently?	**How** can vectors be used to find angles, intersections and minimum distances, **why** are these techniques powerful, and **how** do they model spatial relationships? **What** makes a project schedule efficient, **why** are critical paths and floats important, and **how** can they be used to optimise completion times? **How** can mathematical models support project planning, **why** must resource constraints be considered, and **how** can scheduling techniques inform decisions?	used to solve problems? **How** can the roots of complex numbers reveal mathematical structure, **why** are they important, and **how** can they be applied in geometry and series? **What** makes a transportation solution optimal, **why** must supply and demand be balanced, and **how** can algorithms minimise costs efficiently? **How** can mathematical optimisation support real-world distribution problems, **why** are iterative improvements needed, and **how** can shadow costs guide decision making?
Assessment (specific assessed piece(s); milestone(s))	L Review 1CP1 L Review 1CP2 L Review D1-1 L Review D1-2	L Review 1CP3 L Review 1CP4 L Review D1-3 December exams	L Review 1CP6 L Review D1-4 L Review D1-5	L Review 1CP7 L Review 1CP8 L Review 1CP5 L Review D1-6	L Review 1CP9 L Review D1-8	Summer exams L Review 2CP1 L Review D2-1