CURIOSITY COMPASSION COURAGE

Curriculum Overview

Subject	Mathematics	Year group	12
Vision statement:	At Landau Forte our curriculum exists to ensure all students regardless of background and ability have the opportunity to unlock their potential. We are committed to students being challenged from their previous key stage learning experiences. Our broad and balanced curriculum is ambitious, coherently planned and sequenced, and will provide the platform for preparing students with the foundations for examination success. Our Curriculum Intent has been informed by a wide variety of researchers and is steeped in evidence based research. Christine Counsell summarises the aspiration of our curriculum to empower all learners creating a pathway to success in university, their career and life: *'A curriculum exists to change the pupil, to give the pupil new power. One acid test for a curriculum is whether it enables even lower attaining or disadvantaged pupils to clamber into the discourse and practices of educated people, so that they gain powers of the powerful.'* As well as excellent academic success we aim to ensure our students leave us as polite and well-rounded young adults. Our new core values of Compassion, Courage and Curiosity are currently being embedded throughout our curriculum offer to ensure we continue to meet our social, emotional, spiritual and moral obligations.		
Curriculum intent:	All students acquire the mathematical life skills necessary for the world of work, no matter what their starting point is, catering for all abilities and backgrounds. We have a strong belief that all students can achieve in Maths. Students will be taught to have a firm understanding of number bonds and be confident in using non-calculator strategies for solving problems. Students will be stretched and challenged through problem solving tasks to develop resilience. Students are encouraged to show **courage** through attempting questions in environment where other students show **compassion** through a culture of being non-judgmental when questions are answered incorrectly. Students are also encouraged to show **curiosity** through asking questions and taking a genuine interest in the real life applications of the Maths that they are learning. This will be achieved by staff working together in planning lessons that allow ALL students to achieve/ exceed their potential through: Common lesson planning formats; Expert knowledge of the subject; Differentiated material; Regular use of AfL to assess progress in a lesson; Regular use of formal marking and feedback; Regular summative assessments to ensure appropriate progress and intervention.		
Threshold Concepts (TCs):	TC1 Algebraic manipulation - This concept involves recognising mathematical properties and relationships using symbolic representation TC2 Number sense - This concept involves understanding the number system and how they are used in a wide variety of mathematical ways TC3 Shape facts - This concept involves recognising the names and properties of geometry shapes and angles. TC4 Multiplicative reasoning - This concept involves using ratio and proportion and understanding of reciprocals in real world applications TC5 Representing and interpreting data - This concept involves interpreting, manipulating and presenting data in various ways. TC6 Calculator skills - This concept involves fluent application of mathematical operations on a scientific calculator TC7 Understanding and calculating risk - This concept involves knowing the rules of probability in the correct context		

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KS4 National Curriculum summary:	The national curriculum for mathematics aims to ensure that all pupils: • become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately. • reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language • can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions. Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. The programme of study for key stage 4 is organised into apparently distinct domains, but pupils should develop and consolidate connections across mathematical ideas. They should build on learning from key stage 3 to further develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge wherever relevant in other subjects and in financial contexts.

Learner skills:

Critical thinking	Organisation	Collaboration	Adaptability	Oracy	Self-quizzing
					

	Term 1 Aug-Oct	Term 2 Nov-Dec	Term 3 Jan-Feb	Term 4 Mar-Apr	Term 5 Apr-May	Term 6 Jun-Jul
Big picture questions:	**How can I square root a negative number?** **How can I use complex numbers to solve quadratic, cubic and quartic equations?**	**What is a matrix?** **How do we multiply and calculate with matrices?** **What is the determinant and inverse of a matrix?** **How do matrices relate to planes and**	**How can I use algorithms to solve problems?** **How efficient are the algorithms being used?** **What is a graph and what important**	**How do we find a minimum spanning tree?** **How do we find shortest distances in a graph?** **What is an Eulerian graph?**	**What are the classical and practical travelling salesman problems?** **How can I find upper and lower bounds for the travelling salesman problem?**	**How can I use integrations to solve three-dimensional problems?** **How can I use critical path analysis to solve resourcing and scheduling problems?**

	What is the modulus and argument of a complex number? **How can I represent loci on an Argand diagram?** **What is a series?** **How do I find the sum of natural numbers?** **How do I find the sum of squares and cubes?** **Are there more efficient ways to find the roots of quadratic, cubic and quartic equations?**	**simultaneous equations?** **How can I use matrices to represent transformations?** **How can we use induction to prove results around series, divisibility and matrices?** **What results can we find involving vectors?**	**definitions are there related to graphs?** **What is a force?** **What is a moment?** **How do I use SUVAT to solve projectile problems?**	**How can we find the shortest route that inspects all the edges?** **What is the principle of conservation of momentum?** **How does momentum relate to vectors?**	**How do work, energy and power relate to each other?** **How can we use Hooke's Law to solve dynamic and equilibrium problems?**	**What are the applications of integration?** **How do I integrate more complex functions?**
Content (Linked to TCs):	TC1 Algebraic manipulation TC2 Number sense TC3 Shape facts TC5 Representing and interpreting data TC6 Calculator skills **Complex Numbers** Imaginary Numbers Multiplying Complex Numbers Complex Conjugation Roots of Quadratic Equations	TC1 Algebraic manipulation TC2 Number sense TC3 Shape facts TC6 Calculator skills **Matrices** Introduction to matrices Matrix Multiplication Determinants Inverting a 2x2 Matrix Inverting a 3x3 Matrix Solving systems of equations using matrices **Linear Transformations** Linear transformations in 2 dimensions Reflections and rotations	TC1 Algebraic manipulation TC2 Number sense TC3 Shapes Facts TC6 Calculator skills **Algorithms** Using and understanding algorithms Flow charts Bubble sort Quick sort Bin-packing algorithms Order of an algorithm **Graphs and Networks** Modelling with graphs Graph Theory Special types of graph	TC1 Algebraic manipulation TC2 Number sense TC3 Shapes Facts TC6 Calculator skills **Algorithms on Graphs** Kruskal's algorithm Prim's algorithm Prim's algorithm on a distance matrix Dijkstra's algorithm to find a shortest path Floyd's algorithm **Route Inspection** Eulerian Graphs Route Inspection algorithm	TC1 Algebraic manipulation TC2 Number sense TC3 Shapes Facts TC6 Calculator skills **Travelling Salesman Problem** **Work, Energy and Power** Work done Kinetic and potential energy Conservation of mechanical energy and the work-energy principle Power	TC1 Algebraic manipulation TC2 Number sense TC3 Shapes Facts TC6 Calculator skills **Volumes of Revolution** Volumes of revolution around the x-axis Volumes of revolution around the y-axis Adding and subtracting volumes Modelling with volumes of revolution. **Critical Path Analysis** Modelling a project

	Solving Cubic and Quartic Equations **Argand Diagrams** Argand Diagrams Modulus and Argument Modulus-argument form of complex numbers Loci in Argand Diagrams Regions in the Argand Diagram **Series** Sum of Natural Numbers Sum of Squares Sum of Cubes **Roots of Polynomials** Roots of a Quadratic Equation Roots of a Cubic Equation Roots of a Quartic Equation Expressions relating to roots of polynomials Linear Transformations of roots	Enlargements and stretches Successive transformations Linear transformations in 3 dimensions The inverse of a linear transformation **Proof by Induction** Proof by mathematical induction Proving divisibility results Proving statements involving matrices **Vectors** Equation of a line in three dimensions Equation of a plane in three dimensions Scalar Product Calculating angles between lines and planes. Points of intersection Finding Perpendiculars	Representing graphs and networks using matrices The planarity algorithm **A Level Mechanics** Forces and Motion Resolving Forces Inclined Planes Friction Moments Projectiles Statics Dynamics Connected Particles	Networks with more than four odd nodes **Momentum and Impulse** Momentum in one direction Conservation of momentum Momentum as a vector	**Elastic Springs and Strings** Hooke's law Equilibrium problems Dynamics problems Elastic energy Problems involving elastic energy	Dummy Activities Early and late event times Critical Activities Float of an activity Gantt Charts Resource Histograms Scheduling Diagrams **Year 13 Differentiation and Integration** Chain Rule Product Rule Quotient Rule Integration using a substitution Integration by parts Integration using reverse chain rule

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Key vocabulary:						
	Complex Numbers Complex number, imaginary number, discriminant, complex conjugate, conjugate pair, quadratic equations, roots, coefficients, real, cubic equations, quartic equations. **Argand Diagrams** Complex numbers, Argand diagram, real axis, imaginary axis, vector, modulus, argument, modulus-argument form, loci, circle, perpendicular bisector, half-line. **Series** Series, sigma notation, natural numbers, constant terms, squares cubes. **Roots of Polynomials** Polynomials, roots, quadratic equations, cubic equations, quartic equations, quintic equations, coefficients, linear transformations.	**Matrices** Matrix, array, elements, size, square matrix, zero matrix, identity matrix, scalar, product matrix, multiplicatively conformable, commutative, determinant, 2x2 matrix, 3x3 matrix, singular, non-singular, minor, inverse matrix, transpose, cofactor, matrix of minors, matrix of cofactors, plane, sheaf, intersection, simultaneous equations, consistent, inconsistent, infinitely many solutions. **Linear Transformations** Linear transformations, matrix, image, reflections, rotations, right-hand-rule, invariant points, invariant lines, enlargement, stretch, scale factor, area scale factor, successive transformations, inverse transformations. **Proof by Induction** Series, matrices, divisibility results, base step, assumption, induction, conclusion.	**Algorithms** Algorithm, instructions, iteration, flow chart, decision, sort, bubble sort, quick sort, bin-packing, first fit, first fit decreasing, full bins, order, complexity. **Graphs and Networks** Graph, vertices, nodes, edges, arcs, weight, weighted graph, network, vertex set, edge set, subgraph, degree, order, valency, walk, path, trail, cycle, Hamiltonian cycle, connected, loop, simple graph, directed graph, handshaking lemma, tree, spanning tree, complete graph, isomorphic graph, colouring, proper colouring, adjacency matrix, distance matrix, planar graph, Planarity algorithm. **A Level Mechanics** Moments, equilibrium, centre of mass, forces, resolving, inclined plane, resultant forces, friction, gravity, projectile, horizontal, vertical, motion, statics, rigid,	**Algorithms on Graphs** Minimum spanning tree, Kruskal's algorithm, Prim's algorithm, distance matrix, weighted graph, shortest path, Dijkstra's algorithm, working value, final label, Floyd's algorithm, distance table, route table. **Route Inspection** Eulerian graph, trail, Eulerian circuit, even degree, odd degree, connected graph, semi-Eulerian graph, route inspection algorithm, shortest route. **Momentum and Impulse** Momentum, velocity, one dimension, constant force, impulse, final momentum, initial momentum, change in momentum, impulse of momentum, conservation of momentum, collision.	**Travelling Salesman Problem** Walk, tour, practical problem, classical problem, upper bound, lower bound, triangle inequality, table of least distances, minimum spanning tree, shortcuts, initial upper bound, residual minimum spanning tree, nearest neighbour algorithm. **Work, Energy and Power** Work done, component of a force, mass, acceleration, work done against gravity, kinetic energy, potential energy, mechanical energy, power. **Elastic Strings and Springs** Stretch, tension, extension, modulus of elasticity, Hooke's law, dynamic problems, elastic strings, springs, force-distance diagram, work done, joules, elastic potential energy,	**Volumes of Revolution** Volume of revolution, integration, rotation, area, radians, y-axis, x-axis, cross section. **Critical Path Analysis** Activity network, precedence table, dependence table, activity on arc, source node, sink node, dummy activity, early time, late time, duration, forwards pass, backwards pass, critical activity, critical event, critical path, float, Gantt chart, Cascade chart, resource histogram, resource levelling, scheduling diagrams. **Differentiation and Integration** Differential, Derivative, chain rule, product rule, quotient rule, implicit differentiation, first principles, integral, substitution, integration by parts, reverse chain rule.

		Vectors Direction vector, position vector, vector equation of a line, scalar parameter, Cartesian form, equation of a plane, parallel vectors, scalars, zero vectors, normal vector, scalar product, angle between vectors, points of intersection, skew, perpendicular.	connected particles, acceleration, variable acceleration.			
Assessment:	**KLT 1 – Baseline Assessment**	**KLT 2 – Complex Numbers, Argand Diagrams, Series and Roots of Polynomials**	**Year 12 PPE – one Pure AS paper (excluding volumes of revolution)**	**KLT 4 – Applied – mechanics and decision content covered so far.**	**Progression exam – one pure paper and one applied paper with a mix of decision and mechanics.**	**Progression resits**
Key/Historical misconceptions in this unit:	**Complex Numbers** • Confusing imaginary numbers with complex numbers • Not simplifying powers of i correctly. • Not knowing that conjugates of roots are also roots. **Argand Diagrams** • Not knowing that you can simplify the modulus-argument form	**Matrices** • Adding or subtracting matrices that are not the same size. • That when multiplying matrices, AB = BA. • Not including the minus for the middle term when finding determinant of a 3x3 matrix. • Not changing the signs of minors to create	**Algorithms** • Doing the wrong number of iterations or going the wrong direction on a flow chart. • Getting descending and ascending mixed up. • Showing swaps or just the list at the end of each pass in a bubble or quick sort. • Thinking the lower bound in	**Algorithms on Graphs** • Not ordering the arcs first for Kruskals. • That the minimum spanning tree doesn't need to be connected. • Mixing up Prims and Kruskals. • Putting a higher working value in a box in Dijkstra's than the current lower working value.	**Travelling Salesman** • Thinking there is a solution to travelling salesman problem, not just bounds. • Mixing up the practical and classical problems. • Not creating the correct residual minimum spanning tree. • Considering the lowest value in all active columns rather	**Volumes of Revolution** • Integrating with respect to x not y when rotating around the y-axis. • Not putting answers to modelling questions in context. **Critical Path Analysis** • Not using dummys in the correct place in an activity network.

	of a complex number to get it in ordinary form. • Not realising that the modulus of two complex numbers subtracted is the distance between them on the Argand diagram. • Mixing up the different loci: circles, perpendicular bisectors, half-lines etc. **Series** • Incorrectly using the sum of natural numbers. • When finding the sum of a series that starts at r=1, subtracting from k instead of k-1. **Roots of Polynomials** • Not including the correct negatives when	the correct matrix of cofactors. **Linear Transformations** • That a translation is a linear transformation. • Multiplying successive transformation matrices in the wrong order. • Not squaring the determinant for the area scale factor. **Proof by Induction** • Only carrying out one of the basis step and inductive step. • That induction can help you derive statements rather than prove a given statement is true for positive integers. **Vectors** • That there is only one vector equation to	bin packing is the solution **Graphs and Networks** • Thinking weighted graphs are drawn to scale. • That the intersection of two edges is a vertex. • Mixing up definitions like walks, paths etc. • That all distance matrices are symmetrical about the diagonal. **A Level Mechanics** • Not giving the direction of rotation when describing a moment. • Resolving forces incorrectly with inclined planes by failing to take the angles into account. • Using the weight instead of the normal	• Thinking Dijkstra's will give the shortest path between any pair of nodes. • Checking the final routes from the route table properly in Floyd's. **Route Inspection** • That an Eulerian circuit is always a cycle. • Not considering all pairings of odd nodes in the route inspection algorithm. • Incorrectly considering cases where the start and finish node are different so they can have odd degree. **Momentum and Impulse** • That momentum is a scalar not a vector.	than just the latest when doing nearest neighbour on a distance matrix. **Work, Energy and Power** • Not using the component of force in direction of motion when calculating work done. • Not giving the specified degree of accuracy • Thinking kinetic energy can be negative like potential energy. • Not realising work done by a force is equal to the change in kinetic energy. **Elastic Strings and Springs** • Using tension instead of thrust for a compressed elastic spring. • Using the work done in	• Mixing up late and early event times. • Drawing activities in the wrong place on a Gantt chart. **Year 13 Differentiation and Integration** • Using the wrong rule chain rule, quotient rule etc for differentiation. • Making mistakes with the formula for each rule. • Using the wrong rule for integration.

	working with the roots of quadratics, cubics and quartics. • Incorrect rearrangements when looking at expressions relating to the roots of a polynomial.	describe a line (like in Cartesian form) • Errors when solving a set of three simultaneous equations. • Using the wrong angles with questions in context. • Not using the modulus sign in the formula for the acute angle between two intersecting straight lines.	reaction when calculating friction.	• That impulse is a scalar not a vector. • Using the wrong sign for the direction leading to mistakes with negatives. • Not stating the speed and direction of motion when asked for a velocity.	stretching an elastic spring formula when the extension is not within the elastic limit of the string or spring.	
Sequencing:	**We have chosen to sequence the further maths curriculum in this way for a number of reasons. A lot of topics build on each other, for example Argand diagrams can only be learnt once complex numbers have been completed, the same for matrices and linear transformations. Some topics have been moved, such as volumes of revolution, to allow for the pre-requisite knowledge to be taught in A Level Maths first. Some Year 13 A Level knowledge is incorporated into the Year 12 Further Maths curriculum to allow for students to have the pre-requisite knowledge for some of the first Year 13 topics.**					