



CURIOSITY

COMPASSION
Curriculum Overview

COURAGE



Subject	Mathematics	Year group	12
<p>Vision statement:</p>	<p>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.</p> <p>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:</p> <p><i>'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.'</i></p> <p>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.</p>		
<p>Curriculum intent:</p>	<p>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.</p> <p>Students will be taught to have a firm understanding of number bonds and be confident in using non-calculator strategies for solving problems.</p> <p>Students will be stretched and challenged through problem solving tasks to develop resilience.</p> <p>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.</p> <p>This will be achieved by staff working together in planning lessons that allow ALL students to achieve/ exceed their potential through:</p> <ul style="list-style-type: none"> 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. 		
<p>Threshold Concepts (TCs):</p>	<p>TC1 Algebraic manipulation - This concept involves recognising mathematical properties and relationships using symbolic representation</p> <p>TC2 Number sense - This concept involves understanding the number system and how they are used in a wide variety of mathematical ways</p> <p>TC3 Shape facts - This concept involves recognising the names and properties of geometry shapes and angles.</p> <p>TC4 Multiplicative reasoning - This concept involves using ratio and proportion and understanding of reciprocals in real world applications</p> <p>TC5 Representing and interpreting data - This concept involves interpreting, manipulating and presenting data in various ways.</p> <p>TC6 Calculator skills - This concept involves fluent application of mathematical operations on a scientific calculator</p> <p>TC7 Understanding and calculating risk - This concept involves knowing the rules of probability in the correct context</p>		









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<p>KS4 National Curriculum summary:</p>	<p>The national curriculum for mathematics aims to ensure that all pupils:</p> <ul style="list-style-type: none"> • 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. <p>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.</p>					
<p>Learner skills:</p>	<p>Critical thinking</p>  <p>CRITICAL THINKING</p>	<p>Organisation</p>  <p>ORGANISATION</p>	<p>Collaboration</p>  <p>COLLABORATION</p>	<p>Adaptability</p>  <p>ADAPTABILITY</p>	<p>Oracy</p>  <p>ORACY</p>	<p>Self-quizzing</p>  <p>SELF QUIZZING</p>
<p>Big picture questions:</p>	<p>Term 1 Aug-Oct</p> <p>How can I square root a negative number?</p> <p>How can I use complex numbers to solve quadratic, cubic and quartic equations?</p>	<p>Term 2 Nov-Dec</p> <p>What is a matrix?</p> <p>How do we multiply and calculate with matrices?</p> <p>What is the determinant and inverse of a matrix?</p> <p>How do matrices relate to planes and</p>	<p>Term 3 Jan-Feb</p> <p>How can I use algorithms to solve problems?</p> <p>How efficient are the algorithms being used?</p> <p>What is a graph and what important</p>	<p>Term 4 Mar-Apr</p> <p>How do we find a minimum spanning tree?</p> <p>How do we find shortest distances in a graph?</p> <p>What is an Eulerian graph?</p>	<p>Term 5 Apr-May</p> <p>What are the classical and practical travelling salesman problems?</p> <p>How can I find upper and lower bounds for the travelling salesman problem?</p>	<p>Term 6 Jun-Jul</p> <p>How can I use integrations to solve three-dimensional problems?</p> <p>How can I use critical path analysis to solve resourcing and scheduling problems?</p>



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	<p>What is the modulus and argument of a complex number?</p> <p>How can I represent loci on an Argand diagram?</p> <p>What is a series?</p> <p>How do I find the sum of natural numbers?</p> <p>How do I find the sum of squares and cubes?</p> <p>Are there more efficient ways to find the roots of quadratic, cubic and quartic equations?</p>	<p>simultaneous equations?</p> <p>How can I use matrices to represent transformations?</p> <p>How can we use induction to prove results around series, divisibility and matrices?</p> <p>What results can we find involving vectors?</p>	<p>definitions are there related to graphs?</p> <p>What is a discrete random variable?</p> <p>How do I find the variance and expected value of a function of X?</p> <p>How can I use a Poisson distribution to model situations?</p>	<p>What is a geometric distribution?</p> <p>What is the negative binomial distribution?</p>	<p>How do we use hypothesis testing on other distributions?</p> <p>What is the central limit theorem?</p> <p>How is the central limit theorem applied to other distributions?</p>	<p>What are the applications of integration?</p> <p>How do I integrate more complex functions?</p>
<p>Content (Linked to TCs):</p>	<p>TC1 Algebraic manipulation</p> <p>TC2 Number sense</p> <p>TC3 Shape facts</p> <p>TC5 Representing and interpreting data</p> <p>TC6 Calculator skills</p> <p>Complex Numbers</p> <p>Imaginary Numbers</p> <p>Multiplying Complex Numbers</p> <p>Complex Conjugation</p> <p>Roots of Quadratic Equations</p>	<p>TC1 Algebraic manipulation</p> <p>TC2 Number sense</p> <p>TC3 Shape facts</p> <p>TC6 Calculator skills</p> <p>Matrices</p> <p>Introduction to matrices</p> <p>Matrix Multiplication</p> <p>Determinants</p> <p>Inverting a 2x2 Matrix</p> <p>Inverting a 3x3 Matrix</p> <p>Solving systems of equations using matrices</p> <p>Linear Transformations</p> <p>Linear transformations in 2 dimensions</p>	<p>TC1 Algebraic manipulation</p> <p>TC2 Number sense</p> <p>TC3 Shapes Facts</p> <p>TC5 Representing and interpreting data</p> <p>TC6 Calculator skills</p> <p>TC7 Understanding and calculating risk</p> <p>Algorithms</p> <p>Using and understanding algorithms</p> <p>Flow charts</p> <p>Bubble sort</p> <p>Quick sort</p> <p>Bin-packing algorithms</p>	<p>TC1 Algebraic manipulation</p> <p>TC2 Number sense</p> <p>TC3 Shapes Facts</p> <p>TC5 Representing and interpreting data</p> <p>TC6 Calculator skills</p> <p>TC7 Understanding and calculating risk</p> <p>Algorithms on Graphs</p> <p>Kruskal's algorithm</p> <p>Prim's algorithm</p> <p>Prim's algorithm on a distance matrix</p> <p>Dijkstra's algorithm to find a shortest path</p>	<p>TC1 Algebraic manipulation</p> <p>TC2 Number sense</p> <p>TC3 Shapes Facts</p> <p>TC6 Calculator skills</p> <p>TC7 Understanding and calculating risk</p> <p>Travelling Salesman Problem</p> <p>Work, Energy and Power</p> <p>Work done</p> <p>Kinetic and potential energy</p> <p>Conservation of mechanical energy and</p>	<p>TC1 Algebraic manipulation</p> <p>TC2 Number sense</p> <p>TC3 Shapes Facts</p> <p>TC6 Calculator skills</p> <p>Volumes of Revolution</p> <p>Volumes of revolution around the x-axis</p> <p>Volumes of revolution around the y-axis</p> <p>Adding and subtracting volumes</p> <p>Modelling with volumes of revolution.</p> <p>Critical Path Analysis</p>



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	<p>Solving Cubic and Quartic Equations</p> <p>Argand Diagrams Argand Diagrams Modulus and Argument Modulus-argument form of complex numbers Loci in Argand Diagrams Regions in the Argand Diagram</p> <p>Series Sum of Natural Numbers Sum of Squares Sum of Cubes</p> <p>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</p>	<p>Reflections and rotations Enlargements and stretches Successive transformations Linear transformations in 3 dimensions The inverse of a linear transformation</p> <p>Proof by Induction Proof by mathematical induction Proving divisibility results Proving statements involving matrices</p> <p>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</p>	<p>Order of an algorithm</p> <p>Graphs and Networks Modelling with graphs Graph Theory Special types of graph Representing graphs and networks using matrices The planarity algorithm</p> <p>Discrete Random Variables Expected value of a discrete random variable Variance of a discrete random variable Expected value and variance of a function of X Solving problems involving random variables</p> <p>Poisson Distributions The Poisson Distribution Modelling with the Poisson distribution Adding Poisson distributions Mean and variance of a Poisson distribution Mean and variance of the binomial distribution Using the Poisson distribution to approximate the binomial distribution</p>	<p>Floyd's algorithm</p> <p>Route Inspection Eulerian Graphs Route Inspection algorithm Networks with more than four odd nodes</p> <p>Momentum and Impulse Momentum in one direction Conservation of momentum Momentum as a vector</p> <p>Geometric and Negative Binomial Distributions The geometric distribution Mean and variance of a geometric distribution The negative binomial distribution Mean and variance of the negative binomial distribution</p>	<p>the work-energy principle Power</p> <p>Elastic Springs and Strings Hooke's law Equilibrium problems Dynamics problems Elastic energy Problems involving elastic energy</p> <p>Hypothesis Testing Testing for the mean of a Poisson distribution Finding critical regions for a Poisson distribution Hypothesis testing for the parameter p of a geometric distribution Finding critical regions for a geometric distribution</p> <p>The Central Limit Theorem The Central Limit Theorem Applying the central limit theorem to other distributions</p>	<p>Modelling a project Dummy Activities Early and late event times Critical Activities Float of an activity Gantt Charts Resource Histograms Scheduling Diagrams</p> <p>Year 13 Differentiation and Integration Chain Rule Product Rule Quotient Rule Integration using a substitution Integration by parts Integration using reverse chain rule</p>
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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.

Discrete Random Variables

Random variable, discrete, expected value, mean, variance.

Poisson distributions

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.

Geometric and negative binomial distributions

Geometric distribution, independent trials, probability of success, probability function, cumulative geometric distribution, mean, variance, negative binomial distribution

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.

Hypothesis Testing

Hypothesis test, null hypothesis, alternative hypothesis, mean, Poisson distribution, critical regions, one-tailed test, two-tailed test, critical value, significance level, actual significance level, geometric distribution.

Central Limit Theorem

Central limit theorem, sample mean, approximate, Poisson distribution, geometric distribution, binomial distribution, negative binomial distribution.

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.



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		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.	Poisson distribution, exponential function, probability distribution, parameter, model, independent, constant average rate, mean, variance, probability mass function, binomial distribution, Poisson approximation.			
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 – statistics and decision content covered so far.	Progression exam – one pure paper and one applied paper with a mix of decision and statistics.	Progression resits
Key/Historical misconceptions in this unit:	Complex Numbers <ul style="list-style-type: none"> Confusing imaginary numbers with complex numbers Not simplifying powers of i correctly. Not knowing that conjugates of roots are also roots. Argand Diagrams <ul style="list-style-type: none"> Not knowing that you can simplify the modulus-argument form 	Matrices <ul style="list-style-type: none"> 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 3×3 matrix. Not changing the signs of minors to create 	Algorithms <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Not ordering the arcs first for Kruskals. That the minimum spanning tree doesn't need to be connected. Mixing up Prim's and Kruskals. Putting a higher working value in a box in Dijkstra's than the current lower working value. 	Travelling Salesman <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Integrating with respect to x not y when rotating around the y-axis. Not putting answers to modelling questions in context. Critical Path Analysis <ul style="list-style-type: none"> Not using dummies in the correct place in an activity network.



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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.

Discrete Random Variables

- Not realising the expected value is a theoretical quantity.
- That $E(X^2) = E(X)^2$.

Poisson Distribution

- Not realising this is an infinite probability distribution.

- 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.

Geometric and Negative Binomial Distribution

- Mixing up the standard deviation and the variance.

than just the latest when doing nearest neighbour on a distance matrix.

Hypothesis Testing

- Not halving the critical region when doing a two-tailed test.
- Not understanding the value of tables when finding critical values.

Central Limit Theorem

- Not understanding the sample mean is only an approximation.
- Applying a continuity correction incorrectly.

- 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.



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	<p>working with the roots of quadratics, cubics and quartics.</p> <ul style="list-style-type: none">• Incorrect rearrangements when looking at expressions relating to the roots of a polynomial.	<p>describe a line (like in Cartesian form)</p> <ul style="list-style-type: none">• 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.	<ul style="list-style-type: none">• Mixing up binomial and Poisson distribution.• Mixing up the mass function and the cumulative function.	<ul style="list-style-type: none">• Not applying these distributions to suitable models.		
Sequencing:	<p>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.</p>					