Curriculum Plans: Year 13 (Mathematics)

	Topic	**Knowledge:** **By the end of the unit students will know:**	Skills: What skills will students have developed by the end of this unit?	**Key terms:** **What new key terms and vocabulary will be learnt in this unit?**	**Summative Assessment:** **How will pupils be assessed in this unit?**
Michaelmas 1	Algebraic methods	Proof by contradiction Algebraic fractions Partial fractions Algebraic division (and partial fractions)	Understand and use the structure of mathematical proof, proceeding from given assumptions through a series of logical steps to a conclusion; use methods of proof Add, subtract, multiply, divide and simplify algebraic fractions. Decompose rational functions into partial fractions (denominators not more complicated than squared linear terms and with no more than 3 terms, numerators constant or linear)	Negate Improper fraction Algebraic division Comparing coefficients.	Assessment homework/topic test for each unit conducted either as a homework or mini assessment in class.
	Functions & Graphs	The modulus function Functions and mappings Composite functions Inverse functions Sketching graphs of modulus functions Transforming graphs Solving modulus problems	To define a function. Define domain and range. Transform graphs by a combination of transformations. Understand and use composite functions; inverse functions and their graphs. Understand the effect of simple transformations on the graph of $y = f(x)$, including sketching associated graphs: $y = af(x)$, $y = f(x) + a$, $y = f(x + a)$, $y = f(ax)$ and combinations of these transformations	Function Mapping Domain Range Composite Inverse One-to-one Many-to one Piecewise function Modulus function	

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	Sequences & Series	Arithmetic Sequences and series Geometric Sequences and series Sum to Infinity Sigma notation Recurrence relationships, increasing, decreasing and periodic functions Modelling with series	Work with sequences including those given by a formula for the nth term and those generated by a simple relation of the form xn + 1 = f(xn); increasing sequences; decreasing sequences; periodic sequences Understand and use sigma notation for sums of series. Understand and work with arithmetic sequences and series, including the formulae for nth term and the sum to n terms. Understand and work with geometric sequences and series, including the formulae for the nth term and the sum of a finite geometric series; the sum to infinity of a convergent geometric series, including the use of |r| < 1; modulus notation. Use sequences and series in modelling.	Arithmetic Geometric Converging Diverging Limit Tends towards Oscillating	
	Radians	Recap of radians, arc length, area of sectors and segments. Recap of solving trig equations using radians. Small angle approximations.	Understand and use the standard small angle approximations of sine, cosine and tangent sin , θ θ ≈ 2 cos 1 , 2 θ θ ≈ − tanθ θ ≈ Where θ is in radians.	Tends to Radian Degree Sector Segment	
	Trigonometric functions	Secant, cosecant and cotangent Graphs of sec, cosec and cot. Trigonometric identities. Inverse trig functions	Understand and use the definitions of secant, cosecant and cotangent and of arcsin, arccos and arctan; their relationships to sine, cosine and tangent; understanding of their graphs; their ranges and domains	Secant Cosecant Cotangent Arcsin Arccos Arctan	

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Michaelmas 2	Binomial expansion	Expansion of expressions using Binomial expansion Using Partial fractions	Extend Year 12 content to any rational n, including its use for approximation; be aware that the expansion is valid for Mod(bx/a) < 1 (proof not required) May be used with the expansion of rational functions by decomposition into partial fractions May be asked to comment on the range of validity.	Limit Converge Diverge Mod Valid for	Assessment homework/topic test for each unit conducted either as a homework or mini assessment in class. Pure Assessment.
	Trigonometry and Modelling	Addition formulae. Double angle formulae. Solving trigonometric equations. Rcos(x + a), Rsin(x + a). Proving trig identities. Modelling with trigonometry.	Understand and use sin2θ, cos2θ, tan2θ Understand and use double angle formulae; use of formulae for sin (A ± B), cos (A ± B), and tan (A ± B), understand geometrical proofs of these formulae. To include application to half angles. Knowledge of the tan θ/2 formulae will not be required. Understand and use expressions for acosθ + bsinθ in the equivalent forms of rcos(θ ± α) or rsin (θ ±α) Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle. Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces.	Double angle Addition formulae	
	Parametric Equations	Parametric Equations and Cartesian equation conversion Curve sketching Points of intersection Modelling with parametric equation	Understand and use the parametric equations of curves and conversion between Cartesian and parametric forms. Use parametric equations in modelling in a variety of contexts.	Parametric Parameter Equation Curve	

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	Differentiation	Differentiating sin and cos Differentiating exponentials ad logarithms. The chain rule. The product rule. The quotient rule. Differentiating trig functions. Parametric functions. Implicit differentiation. Using second derivative.	Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions. Differentiate simple functions and relations defined implicitly or parametrically, for first derivative only. Construct simple differential equations in pure mathematics and in context, (contexts may include kinematics, population growth and modelling the relationship between price and demand). Set up a differential equation using given information. For example: In a simple model, the rate of decrease of the radius of the mint is inversely proportional to the square of the radius.	Product Quotient Derivative Implicit Differential	
	Numerical Methods	Locating roots using sign change method. Iteration. The Newton-Raphson method. Applications to modelling.	Locate roots of f(x) = 0 by considering changes of sign of f(x) in an interval of x on which f(x) is sufficiently well behaved. Students should know that sign change is appropriate for continuous functions in a small interval. Understand how change of sign methods can fail. Solve equations approximately using simple iterative methods; be able to draw associated cobweb and staircase diagrams. Solve equations using the Newton-Raphson method and other recurrence relations of the form xn+1= g(xn) Understand how such methods can fail. Understand and use numerical integration of functions, including the use of the trapezium rule	Newton Raphson Root finding Iteration Convergence Divergence Sign change Approximation Error Bisection	

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			and estimating the approximate area under a curve and limits that it must lie between. Use numerical methods to solve problems in context.		
Lent 1	Moments	Moments & resultants moments. Equilibrium. Centre of mass. Tilting.	Understand and use moments in simple static contexts.	Pivot Tilt Turn Point Equilibrium.	Assessment homework/topic test for each unit conducted either as a homework or mini assessment in class. Mock examinations.
	Projectiles	Horizontal projection. Project at any angle. Projection motion formulae.	Model motion under gravity in a vertical plane using vectors; projectiles. Derivation of formulae for time of flight, range and greatest height and the derivation of the equation of the path of a projectile may be required.	Horizontal Vertical Gravity Maximum height Velocity Range Projection.	
	Application of Forces	Static rigid bodies.	Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors); application to problems involving smooth pulleys and connected particles; resolving forces in 2 dimensions; equilibrium of a particle under coplanar forces.	Ladder Force Reaction Equilibrium Newton Horizontal Vertical Moment.	
	Integration	Integrating standard functions and standard patterns. Using trig identities. Reverse chain rule.	Carry out simple cases of integration by substitution and integration by parts; understand these methods as the inverse processes of the chain and product rules respectively (Integration	Inspection Derivative Substitution By parts	

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		Substitution. By parts. Partial fractions. Finding areas. Trapezium rule. Parametric integration.	by substitution includes finding a suitable substitution and is limited to cases where one substitution will lead to a function which can be integrated; integration by parts includes more than one application of the method but excludes reduction formulae.) Integrate using partial fractions that are linear in the denominator. Evaluate the analytical solution of simple first order differential equations with separable integrated; integration by parts includes more than one application of the method but excludes reduction formulae.) Integrate using partial fractions that are linear in the denominator. Evaluate the analytical solution of simple first order differential equations with separable variables, including finding particular solutions (Separation of variables may require factorisation involving a common factor.) Interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; includes links to kinematics.	Approximation Limit/bound	
Lent 2	Further Kinematics	Vectors in kinematics. Vector methods with projectiles. Dynamic and inclined planes. Connected particles	Connected particle problems could include problems with particles in contact e.g. lift problems. Problems may be set where forces need to be resolved, e.g. at least one of the particles is moving on an inclined plane. Understand and use addition of forces; resultant forces; dynamics for motion in a plane. Students	Variable Displacement Acceleration Velocity Position Scalar Vector	Assessment homework/topic test for each unit conducted either as a homework or mini assessment in class.

			may be required to resolve a vector into two components or use a vector diagram, e.g. problems involving two or more forces, given in magnitudedirection form. Understand and use the F ≤ μR model for friction; coefficient of friction; motion of a body on a rough surface; limiting friction and statics. Use calculus in kinematics, with variable acceleration. The level of calculus required will be consistent with that in Sections 7 and 8 in the Pure Mathematics content. Extend to 2 dimensions using vectors.	Equilibrium. Balanced. Friction. Limiting equilibrium. Integrate Differentiate.	
	Regression, correlation and hypothesis testing	Exponential models. Measuring correlation. Hypothesis for zero correlation. p-values for correlation coefficient.	Understand and apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value;	Regression Least-squares Dependent Independent Gradient Intercept Context Interpolate Extrapolate Correlation Positive Negative PMCC Critical value One-tailed Two-tailed p-value.	

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	The Normal Distribution	The normal distribution Finding probabilities. The inverse normal distribution. The standard normal distribution. Approximating a binomial distribution. Hypothesis testing with normal distribution.	Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context. Understand that a sample is being used to make an inference about the population and Hypotheses should be expressed in terms of the population parameter p appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis. Conduct a statistical hypothesis test for the mean of a Normal distribution with known, given or assumed variance and interpret the results in context.	Bell-shaped Symmetrical Probability Mean Standard deviation Standard normal Inverse normal Cumulative Probability tables	
Trinity 1	Revision	All resources shared on Teams			Assessment homework/topic test for each unit conducted either as a homework or mini assessment in class. External A-level examinations