A-Level Maths – Pure Topics

Year 12						
When	**WHAT & WHY WILL THEY LEARN?** (SOW overview linked to assessment Objectives) What do Yr12/13 need to know and be able to do by the time they leave TENC? How do you sequence the teaching? How do you revisit, revise and reinforce?		**New Skill = NS Revisit = R Revision = RV**	**Stretch and Challenge (Differentiation – how will you stretch the most able to achieve top grades?)** Is your curriculum challenging?	**CIEAG/Extension** **Enrichment** Trips, workshops, speakers, local environment and experiences	**KS4 PRIOR LEARNING and OTHER NOTES** How will GCSE knowledge, skills & experience across 3 schools link to and support KS5 new knowledge and skills? This needs to show how you build links across the experiences of the different schools
Term Plan	**KNOWLEDGE & SKILLS**			**Band 5 = Informed Band 6 = Mature**		
	Transition Task • Understand and use the laws of indices for all rational exponents • Use and manipulate surds, including rationalising the denominator. • Work with quadratic functions and their graphs. • Solution of quadratic equations • Completing the square. • Solve simultaneous equations in two variables by elimination and by substitution, including		RV RV RV RV RV	Most topics on Integral include an exercise level 3 task. This should be set as an extension where needed. Below are some links to other tasks that might be a good idea to challenge students' reasoning.	A lot of really good resources here. It includes resources for promoting A level, posters, podcasts and enrichment activities. This link is very worth exploring: Click here Senior Maths Challenge (AMSP) –	All elements of the Transition Task are at the higher end of the GCSE syllabus except the polynomial division. It is expected that students start in September with a strong foundation of these algebraic concepts.

	one linear and one quadratic equation. • Manipulate polynomials algebraically, including expanding brackets and collecting like terms, factorisation and simple algebraic division		RV NS		Individual papers usually about November and a Team competition too. (Link) Ritangle – Competition for students (Link)	
Term 1	Proof – • Proof by deduction • Proof by exhaustion • Disproof by counter example Algebra – • Solve linear and quadratic inequalities in a single variable and interpret such inequalities graphically, including inequalities with brackets and fractions. • Express solutions through correct use of 'and' and 'or', or through set notation. • Represent linear and quadratic inequalities such as		NS NS NS RV/NS NS RV	Proof (Underground Maths) Inequalities (Underground Maths) Simultaneous Equations (RISP)	My Favourite Problem Posters (AMSP) Problem Solving Business Cards (AMSP) Taking Maths Further Podcasts Taking Maths Further Podcasts (FMSP) Enrichment Posters (FMSP)	Understanding numbers written algebraically is covered at GCSE (e.g. 2n+1 for an odd number). Proof is continued and in Year 13 and revisited in several other topics. Most algebra topics covered at GCSE. Very important to master Quadratics and general manipulation to help with other topics.

	$y > x + 1$ and $y > ax^2 + bx + c$ graphically • Understand and use graphs of functions; sketch curves defined by simple equations including polynomials, $y = a/x$ • Interpret algebraic solution of equations graphically; use intersection points of graphs to solve equations • Understand and use proportional relationships and their graphs. • Understand the effect of simple transformations on the graph of $y = f(x)$, including sketching associated graphs: • $y = af(x)$, • $y = f(x) + a$, • $y = f(x + a)$, • $y = f(ax)$ Coordinate Geometry • Understand and use the equation of a straight line, including the forms $y – y1 = m(x – x1)$ and $ax + by + c = 0$; • Gradient conditions for two straight lines to be parallel or perpendicular		RV RV NS RV NS RV	Asymptotes task (Underground) Transformations (Card Sort)	Year 12 Problem Solving Tasks (FMSP)	Simultaneous equations mostly done by elimination at GCSE, substitution is important at several points in A-level and often needs more practice. Transformations at this stage no more difficult to than GCSE, important to have fluency with all graphs. Linear graphs only really in y=mx+c form at GCSE, need to recognise alternatives at A-level.

	• Understand and use the coordinate geometry of the circle including using the equation of a circle in the form $(x – a)^2 + (y – b)^2 = r^2$ • Completing the square to find the centre and radius of a circle; use of the following properties: ● the angle in a semicircle is a right angle ● the perpendicular from the centre to a chord bisects the chord ● the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point. Calculus - Differentitation • Understand and use the derivative of f(x) as the gradient of the tangent to the graph of y = f(x) at a general point (x, y); the gradient of the tangent as a limit; interpretation as a rate of change • sketching the gradient function for a given curve		NS NS NS NS	Teddy Bear Circles (Underground Maths) Circles from Points (Underground Maths) Group Task Ideas Gradient Function Card Sort (Underground Maths)		Circles all centred at origin in GCSE, moving around at A-level. Differentiation is covered in GCSE Further Maths but not normal GCSE. They son's look at first principles though.

	• differentiation from first principles for small positive integer powers of • Understand and use the second derivative as the rate of change of gradient; • Differentiate x^n , for rational values of n, and related constant multiples, sums and differences. • Apply differentiation to find gradients, tangents and normal, maxima and minima and stationary points. • Identify where functions are increasing or decreasing. Calculus – Integration • Know and use the Fundamental Theorem of Calculus • Integrate x^n (excluding n = −1) and related sums, differences and constant multiples. • Evaluate definite integrals; use a definite integral to find the area under a curve Trigonometry		NS NS NS NS NS NS NS NS	Tangent or Normal (Underground Maths) Integration/Differentiation Tarsia Finding Area (Spot the Errors)		Make sure to use different representations rather than just dy/dx and use a variety of terms to aid exam practice. Trapezium rule is in GCSE, could be a way to start looking at areas.

	• Understand and use the definitions of sine, cosine and tangent for all arguments; • the sine and cosine rules; the area of a triangle in the form 1/2 ab sinC • Understand and use the sine, cosine and tangent functions; their graphs, symmetries and periodicity. • Understand and use sin θ/cos θ = tan θ • Understand and use $\sin^2 \theta + \cos^2 \theta = 1$ • Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle. APPLIED Chapter 11 – Sampling, data, presentation and interpretation - Populations and sampling - Representing data - Location: mean, median, mode and range		RV RV NS NS NS NS R NS R R	Sorting Solutions (Card Sort) Solving Equations (Spot the Errors) Sine/Cosine Rule Investigation (RISP) Sine Rule Proof (Underground Maths) Histogram Puzzle (Integral) Measures of Spread (Making		Sine, Cosine and Area rules at GCSE. Graphs are covered at GCSE but only briefly. Good to link back to Unit Circle as this is something that often wouldn't have been looked at in GCSE. **Throughout the delivery of the Statistics topics reference will need to be made to the "large data set" which forms part of the assessment for this unit. This is best done as work is completed rather than as an add on task.**

	- Dispersion - Correlation and regression Chapter 15 – Kinematics - Motion graphs - Constant acceleration question - Non-uniform acceleration Chapter 16 – Forces and Newtons laws - Modelling in Mechanics - Constant acceleration - Forces and motion - Newtons laws of motion Chapter 12 – Probability - Elementary probability - Solving probability problems - Laws of probability		NS NS R NS NS NS NS NS NS NS R R NS	Statistics Vital - MSV- Activity) Practical Ideas (STEM) Deriving SUVAT (Card Sort) Speed vs Velocity (Underground Maths) Practical Spring Activity (STEM) Balls in a Box (MSV) Two Dominoes Problem (MSV)		**Link to Large Data Set resources** GCSE statistics; basic understanding of conducting surveys/ questionnaires. GCSE physics and SUVAT equations Diagrams for force questions are an absolute must! This needs to be stressed and modelled in lessons. Group work creating a force diagram at the start of a question work well Venn diagrams, tree diagrams, probability are all familiar to students at GCSE
Term 2	Binomial Expansion • Understand and use the binomial expansion of $(a + bx)^n$ for positive integer n; the		NS	Pascal's Triangle (RISP)		New topic but some may have come across Pascal's Triangle before. Might be

	notations n! and nCr link to binomial probabilities. Exponentials and Logarithms • Know and use the function a^x and its graph, where a is positive. • Know and use the function e^x and its graph. • Know that the gradient of e^{kx} is equal to ke^{kx} and hence understand why the exponential model is suitable in many applications. • Know and use the definition of $\log_a x$ as the inverse of a^x, where a is positive and x is greater than or equal to 0. • Know and use the function ln x and its graph • Know and use ln x as the inverse function of e^x • Understand and use the laws of logarithms: • $\log_a x + \log_a y = \log_a (xy)$ • $\log_a x - \log_a y = \log_a x/y$ • $k \log_a x = \log_a x^k$ (including, for example, k = −1 and k = – ½ • Solve equations of the form $a^x = b$		NS NS NS NS NS NS NS NS NS NS NS	Problem (Underground Maths) Group Task Ideas Log graph transformations (Integral) Log Equations Investigation (RISP) Modelling card sort (Introduction?)		good fun to use the RISP to introduce it. Fluency with quadratics and algebraic manipulation is vital here. Can look at graphs and transformations again, linking in other areas as revision.

	• Use logarithmic graphs to estimate parameters in relationships of the form $y = ax^n$ and $y = kb^x$, given data for x and y • Understand and use exponential growth and decay; use in modelling (examples may include the use of e in continuous compound interest, radioactive decay, drug concentration decay, exponential growth as a model for population growth); consideration of limitations and refinements of exponential models. Vectors • Use vectors in two dimensions • Calculate the magnitude and direction of a vector and convert between component form and magnitude/direction form • Add vectors diagrammatically and perform the algebraic operations of vector addition and multiplication by scalars, and understand their geometrical interpretations.		NS NS RV NS RV	Card Sort Activity (Integral)		Vectors are covered at GCSE and this doesn't really go much further. Work is often needed on the more awkward diagram questions.

	• Understand and use position vectors; calculate the distance between two points represented by position vectors. • Use vectors to solve problems in pure mathematics and in context (including forces). APPLIED Chapter 13 – statistical distributions - Probability distributions - Binomial distribution - Cumulative binomial distribution - Modelling real life problems Chapter 14 – Statistical Hypothesis testing - Hypothesis tests - One-tailed and two-tailed testing - Hypothesis testing for the binomial distribution		NS NS NS NS NS NS NS NS NS	Dice Experiment (Introduction to Binomial Dist) Calculator Fluency (Tarsia) Hypothesis Testing (Card Sort)		The use of the scientific statistics functions are first developed here and students need to become familiar with shortcuts that the calculator is capable of. Tables not used for the normal distribution, instead pupils need to use their calculator

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Term 3	Algebra and Functions • Simplify rational expressions, including by factorising and cancelling, and algebraic division (by linear expressions only). • Understand and use the modulus of a linear function. • Understand and use composite functions; inverse functions and their graphs. • 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) • Understand the effect of combinations of transformations on the graph of y = f(x) Trigonometry • Work with radian measure, including use for arc length and area of sector. • Know and use exact values of sin, cos and tan in radians		R NS NS NS NS NS	Domain/Range Grid (Integral) Domain/Range Card Sort (Integral) Modulus Graphs (Card Sort) Solving modulus Equation (Spot the Error) Composite Functions (RISP) Partial Fractions (Desmos) Using Radians for Solving (Fluency and communication task)		Basic fraction work is covered in Transition Task and earlier in the course as well as GCSE. Modulus gives another opportunity to work on graph transformations before making them more difficult by combining multiple transformations. Algebraic manipulation is important for the Partial Fractions. Students often tempted to fall back on degrees work for sector area and arc length.

	Differentiation • Differentiate using the product rule, the quotient rule and the chain rule, including problems involving connected rates of change and inverse functions. • Differentiate e^{kx} and ak^x, sin kx, cos kx, tan kx and related sums, differences and constant multiples. Understand and use the derivative of ln x		NS NS	Radians and Degrees (RISP) Properties of Curves (Integral) Chain, Product, Quotient Mix (Card Sort)		The first task to the left may help them see that using radians is much more efficient. Building on differentiation from earlier in the year.

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When	**WHAT & WHY WILL THEY LEARN?** (SOW overview linked to assessment Objectives)		**New Skill = NS** **Revisit = R** **Revision = RV**	**<u>Stretch and Challenge</u>** **(Differentiation – how will you stretch the most able to achieve top grades?)**	**<u>CIEAG/Extension</u>** Trips, workshops, speakers, local environment and experiences	**<u>KS4 PRIOR LEARNING, LINKS AND NOTES</u>** How will GCSE knowledge support new skills & knowledge
Term Plan	**<u>KNOWLEDGE & SKILLS</u>**			**Band 5 = Informed** **Band 6 = Mature**		
	<u>Transition Task</u> • Differentiation – application • Differentiation – Chain, Product and Quotient Rules • Functions, Graphs and Transformations • Trigonometry Problem Solving • Proof		RV RV RV RV RV RV RV		A lot of really good resources here. It includes resources for promoting A level, posters, podcasts and enrichment activities. This link is very worth exploring: Click here Senior Maths Challenge	

The East Northamptonshire College
Ferrers • Huxlow • Rushden

					(AMSP) – Individual papers usually about November and a Team competition too. (Link) Ritangle – Competition for students (Link)	
Term 1	Proof • Proof by contradiction (including proof of the irrationality of 2 and the infinity of primes, and application to unfamiliar proofs). Trigonometry • Understand and use the standard small angle approximations of sine, cosine and tangent $\sin\theta \approx \theta$, $\cos\theta \approx \frac{1}{2}\theta^2$, $\tan\theta \approx \theta$ Where θ is in radians. • 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.		NS NS NS NS	Root 2 is Irrational proof (Card Sort) Proof – Find the Fallacy (Integral) Reciprocal functions (Tarsia) Compound Angles Extension Tasks	My Favourite Problem Posters (AMSP) Problem Solving Business Cards (AMSP) Taking Maths Further Podcasts (FMSP)	Continuation from Year 12 proof, proof by contradiction is the new element. Look at graphs again and think about the links with domain, range and inverse functions.

	• Understand and use $\sin^2\theta + \cos^2\theta = 1$, $\sec^2\theta = 1 + \tan^2\theta$ and $\text{cosec}^2\theta = 1 + \cot^2\theta$ • Construct proofs involving trigonometric functions and identities. • Solve simple trigonometric equations in a given interval, including quadratic equations in sin, cos and tan and equations involving multiples of the unknown angle. • 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. • Understand and use expressions for a cosθ + bsinθ in the equivalent forms of r cos (θ ± α) or rsin (θ ± α) • Use trigonometric functions to solve problems in context, including problems involving vectors, kinematics and forces. Sequences and Series • Extend to any rational n, including its use for approximation; be aware that the expansion is valid for |bx/a| < 1 (proof not required)		NS R NS NS NS R/NS RV	Compound Angles Generating Formulae (RISP) Extending the Binomial Expansion (RISP)	Enrichment Posters (FMSP) Year 12 Problem Solving Tasks (FMSP)	Make sure they are fluent on getting from the basic identity covered in Yr 12 to the new alternatives rather than remembering all three. Basic Sequences covered at GCSE including iterative formulae.

	• Work with sequences including those given by a formula for the nth term and those generated by a simple relation of the form $x_{n+1} = f(x_n)$; 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. Vectors • Use vectors in two dimensions and in three dimensions Differentiation • Understand and use the second derivative as the rate of change of		NS NS NS NS R/NS R	Doing and Undoing Binomial Expansion (RISP) Sequences (RISP) Arithmetic and Geometric Investigation (RISP) Intro to Implicit Diff (RISP)		New notation here at A-level is important. Can link back to proofs and look at visual proofs for summing series here too. Only difference is three dimensions. Link to 3D Pythagoras covered at GCSE for the modulus of the 3D vector.

	gradient; connection to convex and concave sections of curves and points of inflection. • Apply differentiation to find and classify maxima and minima, stationary points and points of inflection • 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). Parametric Equations • 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. APPLIED Mechanics – Chapter 29 Kinematics 2 - Projectiles		R R NS NS NS NS NS	Advanced Arithmagons (inc. differentiation) Parametric Pictures (Using technology)		Importance of not just using x and y comes in here. Understanding that we're differentiating 'with respect to __' Use graphing software (desmos, geogebra, or autograph) to explore graphs.

	- Non-uniform acceleration in 2 dimensions Chapter 30 – Dynamics - Resolving forces - Resolving forces involving friction - Newtons laws of motion Chapter 31 – Moments - introduction to moments - reaction forces and friction in moment		RS NS NS NS NS	Practical Ideas (STEM) Forces on Slope (Spot the Error) Moments Practical (STEM) Moments Practical 2 (STEM)		Projectiles builds on year 12 work to now include inclines. SUVAT revisited Vital that diagrams are drawn accurately One of the more challenging topics of AS maths requiring revisiting
Term 2	Integration • Integrate x^n (excluding n = −1) and related sums, differences and constant multiples. • Integrate e^{kx}, 1/x , sinkx , cos kx and related sums, differences and constant multiples.		R NS R/NS	Meaningful Areas (Underground Maths) Substitution (Spot the Error)		Probably the most challenging aspect of the course. Really important to be able to identify when to integrate and what the best method is for that particular question.

	• Evaluate definite integrals; use a definite integral to find the area under a curve and the area between two curves • Understand and use integration as the limit of a sum. • 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 • 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 • Interpret the solution of a differential equation in the context of solving a problem, including identifying limitations of the solution; includes links to kinematics. Numerical Methods • 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.		NS NS NS NS NS NS NS	[Approximating solutions](#) (RISP) [Is the Serpentine](#)		Some iterative formulae used at GCSE Trapezium rule is used at GCSE

	• 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 $x_{n+1} = g(x_n)$ • Understand how such methods can fail. • Understand and use numerical integration of functions, including the use of the trapezium rule and estimating the approximate area under a curve and limits that it must lie between. • Use numerical methods to solve problems in context. APPLIED Chapter 26 – Correlation and regression - PMCC - Rank correlation Chapter 27 – Probability 2		NS NS NS RV NS NS NS NS	really 40 acres? (Numerical Integration Underground Maths) Independent Dice (MSV)		Should understand visually what is happening and why these iterations find (or don't find) roots. Correlation is new but links to the ideas covered at GCSE in terms of lines of best fit. Need to be familiar with calculators but also aware of the tables in formula books Building in Yr 12 work and GCSE. Important to

	- Conditional probability - Modelling with probability Chapter 28 – the Normal distribution - The Normal distribution - Normal approximation to a Binomial distribution - Choosing probability distributions - Hypothesis tests of the mean of a population		NS NS NS NS NS	Independence Task (MSV) Coffee Problem (Norm dist. MSV) Sample Mean Gap Fill (MSV)		understand Venn and Tree diagrams. New topic but the idea of hypothesis testing links back to Yr 12. Again, need to be very familiar with calculator.