Mathematics is the music of reason

Long Term Plan Year 11 Mathematics

Half Term	Unit Title	Key Knowledge/Content to learn and retain	Essential Skills to acquire (subject & generic)	Link to intent and ethos	Anticipated misconceptions	Links to previous KS	Link to future KS	Opportunity for stretch and high prior attainers	SMSC & British Values	Cultural Capital	Career Link
AUT 1		standard form Similarity	Work with numbers greater than 1 in standard form Work with numbers between 0 and 1 in standard form Compare and order numbers in standard form Mentally calculate with numbers in standard form Add and subtract numbers in standard form Multiply and divide numbers in standard form Identify similar shapes Work out missing sides and angles in a given pair of similar shapes Establish a pair of triangles are similar Understand the difference between congruence and similarity Understand and use conditions for congruent triangles	The study of stars, moons and planets involves huge numbers . Astronomers use standard form to write or type very large quantities. This makes it easier for them to complare the quantities and it allos them to calculate with and wwithout calculator. The Sun has a mass of 1.988 x 10^{30}kg. This is a number with 27 zeros and it would be clumsy and impractical to have to write it out each time you wanted to use it. When you enlarge a photo, project and image onto a screen or make scaled models youoare dealing with similarity. Many toys and other objects are scaled, but similar, versions of larger objects from real life	That you move the decimal poin Students may still hold misconceptions related to the first index laws, thinking that 10n × 10m = 10nm rather than 10(n + m) and similar for division. Again by encouraging student. Some students may not fully appreciate the need for standard form, particularly in writing numbers such as 300 Labelling: students need to be fluent in labelling triangles and general polygons in a consistent way Ratio and proportion: students do not always use the correct terminology	How to multiply and divide by powers of ten, applying their understanding of place value. How to use the four arithmetic operations to calculate efficiently with decimals. How to round to a given number of significant figures. That multiplication and division are commutative. How to use the index laws when multiplying and dividing How to label angles correctly. What the symbols corresponding to parallel, perpendicular and equality look like on a diagram. How to prove that two triangles are congruent. How to solve simple linear equations. How to recognise numbers in equivalent ratios	Indices. These are reinforced early on in the Core topics and are used extensively throughout the course. Applications within physics, chemistry and biology. The effect of increasing a length by a factor and how that changes the area and volume is studied in the topic of differentiation under rates of change. In addition to this, matrices can be used to describe enlargements of objects described in two and three dimensions	Speed of light (within compound measures, i.e. speed, distance and time). Further indices laws (fractional). students could explore the NRICH ‘Matter of Scale’ activity to provide another proof of Pythagoras’ theorem. The notion of similar triangles is central to the ideas of Trigonometry and used in some parts of the proofs of the circle theorems		The Penguin Dictionary of Curious and Interesting Numbers by David Wells	Astronomer Alternative titles for this job includeAstrophysicist Astronomers study the origin and structure of the universe, including its planets, stars, galaxies and black holes. Aerospace engineer Aerospace engineers design, build and maintain planes, spacecraft and satellites

AUT 2		Working with Circle	Recognise and label parts of a circle Calculate fractional parts of a circle Calculate the lengths of an arc Calculated the area of a sector Understand and use the volume of a cylinder and a cone Understand and use the volume of a sphere Understand and use the surface areas of a sphere Understand and used the surface area of a cylinder and a cone.	Ordering the right quantity of turf for a sports field, preparing detailed floor plans, and working out how much fertiliser is needed to treat a field crop all require knowledge and calculations of area	students do not state the units when finding the length of an unknown Students struggle to remember the different formulae for finding area students confuse the order of operations when calculating the area of a circle Students struggle to identify the known shapes that make the composite shapes and miss parts of the shapes out of their calculations.	Properties and definitions of polygons, particularly triangles and quadrilaterals. Properties of circles. Convert metric units of length. Convert metric units of area. Substitute into algebraic formulae and expressions. Solve equations formed from area formulae to calculate the value of the unknown (and recognise that where lengths of shapes are involved the value of the unknown must be positive)	Students will start to study calculus at A level and will learn how to use integration to calculate the area under a curve. It is here that many will first consider area to actually be the sum of infinitely thin strips rather than the number of square units that fill the space.	NRICH 'Curvy Areas' is particularly good for exploring compound shapes involving circles and parts of circles. It also has opportunities to revise constructions at the same time. You may find that students are surprised when the areas are all equal. Students can then get experience in generalising these types of problems based on the number of sections the diameter is split into		Infinite Powers by Steven Strogatz	Farm manager Farmers and farm managers grow crops and raise farm animals for food production.
		Vectors	Understand and represent vectors Use and read vector notation Draw and understand vectors multiplied by a scalar Draw and understand addition of vectors Draw and understand addition and subtraction of vectors	Vectors are used in navigations to make sure that two ships don't crash into each other. They are used to model objects sliding down slopes with varying amounts of friction. They can be used to work out how far an object can tilt without tipping over and much more.	Confusing x- and y- values When working with column vectors, some students confuse the x- and y-axis and which direction of movement the values refer Assuming all vectors start at the origins Understanding that equal vectors are also parallel vectors Students may not understand what –a means geometrically in relation to a. Understanding that addition is commutative in vector arithmetic	Basic arithmetic skills including addition, subtraction, multiplication and division (for finding fractions of amounts) of both positive and negative numbers. How to plot coordinates in all four quadrants, understanding that the x- and y- coordinates are distances in horizontal and vertical directions from the origin Basic ratio including connections to proportion e.g. 2 : 3 is 2/5 and 3/5 of the whole. How to solve simple linear equations	This is a relatively straightforward topic at GCSE that will be built upon at KS5. Having strong foundations in this concept will be necessary for students to extend their knowledge at A level. In addition to column vectors and displacement vector notation, students will also learn to write and operate on vectors in their component form and extend in to 3D. They will also work mainly with position vectors and learn to write the equation of a straight line using a position vector, displacement vector and scalar, and also convert between Cartesian and vector forms of straight lines. Students may then also go on to learn additional vector operations, work with vector equations of planes and extend their linear algebra knowledge to matrices. Students may also use vectors when they look at	The NRICH 'Vector Journeys' task can be extended into a second problem, NRICH 'Vector Walk', which explores all possible combinations of vector addition to arrive at a new coordinate point. By allowing multiple uses of the two vectors, students can also discover vector multiplication by a scalar as repeated addition. (nrich.maths.org).			Airline pilot Airline pilots fly passengers and cargo to destinations around the world.

							acceleration in a given direction and form vector equations of straight lines where the scalar represents time				
SPR		Simultaneous equations	Understand that equations can have more than one solution Determine whether a given (x, y) is a solution to a pair of linear simultaneous equations Solve a pair of linear simultaneous equations by substituting a known variable Solve a pair of linear simultaneous equations by substituting an expression Solve a pair of linear simultaneous equations using graphs Solve a pair of linear simultaneous equations by subtracting equations	Accounting involves a great deal of mathematics. Accountant set up computer spreadsheets to calculate and analyse data. Programs such at Microsoft excel work by applying different equations to values in columns or cells, so you needs to know what equations or formulae to use to get the result you needed	Lack of understanding that adding a negative is equal to subtraction and so on. Not applying an operation to every term on both sides of the equation but to selected terms Leaving their solutions to simultaneous equations incomplete by forgetting to find the value of the second variable. Wanting to give exact or decimalised answers rather than working on their solutions in fractional form.	Use variables correctly to form algebraic expressions. How to factorise quadratics in the form: x2 + bx + c Inverse operations. How to graph linear functions. How to graph quadratic function	Solving forms a large part of the future Mathematics students will study. Students will learn how to manipulate equations containing a larger range of functions to find multiple solutions and have a greater understanding about the number of solutions in a given range. It is important that students understand the connection to graphical representations of functions and what the solutions mean for future study, i.e. that for a y = f(x) in solving f(x) = 0 they are finding the intersection of the curve with the x-axis. They will also extend their work on quadratics to look at higher order polynomials, including cubics, and learn about other features of graphs. The ideas surrounding inverses will also be covered in greater detail with students learning about the domain and range of functions as well as the restrictions on these that must sometimes be in place for an inverse to exist. Finally, the work students start on numerical methods will be covered in more detail at A level and students will learn a wider range of iterative methods. Understanding why iterative methods are still needed for functions we can't easily solve sets the groundwork for future work on this topic at A level.	NRICH 'Matchless'. Once students are confident with ideas relating to solving simultaneous equations this is a nice problem for them to attempt. The challenge here is that students will need to set up the equations to begin with before forming their own simultaneous equations. You may wish to remove some cards for some groups to promote a discussion of the amount of information required in class. (nrich.maths.org)			Accountant Inserting different equations Focusing on the order of operations checking that the equations are producing the correct answers

		Non-linear graphs Expanding and factorising	Plot and read from quadratic graphs Plot and read from cubic graphs #Plot and read from reciprocal graphs Recognise graph shapes Identify and interpret roots and intercepts of quadratics Expand binomials (R) Factorise quadratic expressions Solve equations equal to 0 Solve quadratic equations by factorisation	Graphs are used to process information, make predictions and generalise patterns from sets of data. The nature of the data and the relationships between values reveals the shape and form of the graph. Situations that involve motion, including acceleration, stopping distance, velocity and distance travelled (displacement) can be modelled using quadratic expressions and formulae	Students find it difficult to make connections between the algebraic world and the geometry it can describe The main misconception when moving from equation to the graph has been students using their calculators to calculate a table of values for a quadratic function and incorrectly squaring negative numbers When students move from graphing linear functions to quadratic functions they sometimes have a desire to connect the points with straight lines and consequently the plotted points of their quadratic are connected with line segments rather than a smooth curve Students may not have a good grasp of what the word 'reciprocal' means. Common algebraic misconceptions related to finding the product of expressions missing the product of one or more pairs of terms when expanding the product of two or more polynomials. Confusing product with sum, particularly when negatives are involved Squaring both terms in a perfect square rather than expanding the binomial product The polarities of the constant terms of the linear factors also cause students problems	Plot and interpret straight-line graphs including identifying gradients and y-intercepts. Solving linear equations to find the y or x coordinate given the x or y coordinate respectively. Identifying or constructing parallel lines given an equation of a straight line (in any form). Generate a table of values from a given function. How to simplify expressions by collecting like terms including those with different powers. How to simplify products of expressions	A level mathematics further develops the connections between algebra and geometry. Students who go on to A level will be expected to be fluent in moving between descriptions of the function as a graph and as an equation, and will further their knowledge of circles not centred on the origin. Further to this they will need to answer questions of the type: given two graphs y = f(x) and y = g(x) on the same pair of axes, what do the number of intersections mean for the solutions of the equation f(x) = g(x)? From an application point of view, simple harmonic motion, projectiles and parabolic motion are studied and have foundations in this chapter At A level these manipulation skills are essential. Students will be required to manipulate quadratics with ease between various forms and understand how these different forms connect to features of a quadratic's graph and their knowledge of transformations. They will also learn how to long divide polynomials in order to factorise expressions of higher degree than two. GCSE Mathematics for Edexcel 96 © Cambridge University Press, 2015 Students who work with grid expansion methods can adapt their grids to divide. Those that	NRICH 'More Realistic Electric Kettle' activity could be used. This activity also has connection to a task that could happen in the students' science lessons and offers an opportunity to combine such a lesson. The students get a chance to plot a curve and find a way to figure out the equation of the line. (nrich.maths.org) 'Factorisable Quadratics' from NRICH encourages students to think about whether all quadratics can be factorised and to develop a better understanding of the effect that changing the coefficients has on the factorised form. A selection of the questions can be used with Foundation students (where the coefficient of x2 is 1) or with Higher students (for any coefficient of x2). The students can try some of the suggested examples and then swap to assess if each has found all possibilities. (nrich.maths.org)		Why do Buses Come in Threes? by Rob Eastaway and Jeremy Wyndham How to Solve It by George Polya	Seismologist Seismologists study shock waves created by earthquakes and volcanic activity. They also work in oil, gas and minerals exploration. Forensic collision investigator Forensic collision investigators use science and engineering to investigate the causes of road traffic and vehicle related incidents.

							don't have a conceptual understanding of how the grids support multiplication, and hence division, often struggle to learn a long new algorithm, both in traditional format and employing the use of a grid. A fluency of expansion of two or more binomials, trinomials and larger expressions will be required. A level students often struggle with simple expansions, concluding for example that (x + 5)2 = x2 + 25 or (x + 3)(x2 + 4x + 2) = x3 + 3x2 + 12x + 6. The second example is the reason that students should use grids to multiply rather than arcs to show the products when expanding brackets. Once students have automaticity with expansions and have grasped that they find the product of all possible pairs of terms and sum them, then the use of grids can be stopped. Students who use a method of tracking their products through the use of arcs often miss one or more products, particularly when there are more than two terms in one of the brackets, as in the example above. Many students, particularly weaker candidates, continue to use this method for the duration of the A level course.				