KESTEVEN AND SLEAFORD HIGH SCHOOL

Mathematics Scheme of Learning
Year 9 – Term 3/Number Forms/Changing the subject/Simultaneous Equations/Pythagoras & Trigonometry

Intent – Rationale

An opportunity to introduce new GCSE formulae without students needing the knowledge or methods on how to apply. Early exposure will allow students to be familiar and more confident with formulae when they then need to recall and use them. This term allows gives plenty of opportunity for real world career links at a time when students are considering their futures.

Sequencing – what prior learning does this topic build upon?	Sequencing – what subsequent learning does this topic feed into?
• Year 8 Term 1 powers and multiples, Year 9 Term 2 compound measures • Year 9 Term 1 expanding, factorising and solving equations • Year 9 Term 1 solving equations, Term 3 substitution • Year 9 Term 3 changing the subject, Year 8 Term 5 Pythagoras (HSL Pythagoras)	• GCSE standard forms, A level expressing in index notation for calculus • Year 9 Term 3 Trigonometry, using GCSE formulae to solve problems • Year 9 Term 4 solving simultaneous equations graphically • GCSE trigonometry problems
What are the links with other subjects in the curriculum?	**What are the links to SMSC, British Values and Careers?**
Design and Technology • Trigonometry **Languages** • Solving worded problems • Evaluating the language used in questions **Science** • Indices • Rearranging and using known/given formulae • Standard form	• GB4e

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What are the opportunities for developing literacy skills and developing learner confidence and enjoyment in reading?	What are the opportunities for developing mathematical skills?
• 'Alex's Adventure in Numberland' - Alex Bellows • 'The Math Book' - Clifford Pickover • What's Your Angle, Pythagoras? (Charlesbridge Math Adventures) by Julie Ellis and Phyllis Hornung • Pythagoras: Mathematician and Mystic (Greatest Greek Philosophers) by Louis C Coakley and Dimitra Karamanides	• Links to careers can be made explicit here with standard form large and small numbers and trigonometry. Students can research as a homework task.

Mathematics Scheme of Learning
Year 9 – Term 3

Intent – Concepts

What knowledge will students gain and what skills will they develop as a consequence of this topic?
National Curriculum references • Use simple index notation, including calculating higher powers, e.g. calculate 3^4. Understand the difference between decimal approximations and exact values of roots, e.g. true or false: $\sqrt{82} = 9$. Derive and use negative indices to represent powers less than one $3^{-2} = 1 \div 3^2 = \frac{1}{9}$. Understand and use laws of indices to simplify calculations and expressions, including with algebra, e.g. write $3^5 \times 4^2 \div 3^7$ as a single fraction, simplify $3x^2 \times 4x^4y^5 \div 6xy^2$. Use standard form to express very large and small numbers. Convert between standard form and large and small numbers, e.g. true or false: $3.5 \times 10^4 < 3600$. Order numbers including those in standard form. Calculate and solve problems with standard form, including converting between metric units (such as nanometres) and problems involving percentages, e.g. increase 1.36×10^5 km by 12%. Use a calculator to work with standard form. Calculate with roots and with integer indices. Calculate with standard form A × 10^n, where 1 ≤ A < 10 and n is an integer • Understand and use standard mathematical formulae. Rearrange formulae to change the subject. Use linear and quadratic graphs to estimate values of y for given values of x and vice-versa and to find approximate solutions of simultaneous linear equations. Know the meaning of and identify expressions, identities, formulae and equations. Form expressions, equations and formulae to represent relationships, both given in words and through identifying patterns in relationships. Use informal substitution to find the variable of one variable given the value of others, e.g. given that F=9/5 C+32, convert 95°F to °C. Manipulate known formulae by changing the subject. Formulae will include area, perimeter, surface area and volume of all shapes encountered so far (e.g. trapezia, rectangles, triangles, circles, sectors, cuboids, prisms, cylinders), linear graphs in all forms e.g. 3x-4y=15, and any other familiar relationship such as temperature conversion. Solve problems using known formulae

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- Interpret mathematical relationships both algebraically and geometrically. Identify and construct congruent triangles, and construct similar shapes by enlargement, with and without co-ordinate grids. Apply angle facts, triangle congruence, similarity and properties of quadrilaterals to derive results about angles and sides, including Pythagoras' Theorem, and use known results to obtain simple proofs, Use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles

Know

Simplify expressions using index notation – multiply and divide laws, power raised to a power, power 0,1. Write multiples of 10 as a power of 10. Write big and small numbers in standard form. Multiply and divide in standard form.

Substitute values in to an expression or formula (recap alongside equation and identity definitions). Solve an equation by trial and improvement. Change the subject of a formula.

Solve algebraically linear simultaneous equations.

Know and use Pythagoras' theorem to find any side of a right-angled triangle. Know the three trigonometric ratios. Use trig to find any side of a right-angled triangle. Use trig to find any angle in a right-angled triangle.

Apply

Standard form in context e.g. space, cells

Use known formulae e.g. SDT, volume

Pythagoras and trig in context problems – relate to careers to e.g. architecture, engineering

Extend

Expressions with fractions, coefficients and where BIDMAS and directed numbers need to be carefully considered.

Formula where the variable appears more than once (recap factorising by common factors). GCSE formulae e.g. volume of cone, quadratic formula, cosine rule.

Exact answers. Is this triangle right angled? Language including angle of elevation and depression, bearings problems.

What subject specific language will be used and developed in this topic?	**What opportunities are available for assessing the progress of students?**

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Multiply. Index/indices. Power. Base. Root. Square. Cube. Divide. Simplify. Evaluate. Standard form. Approximate. Exact. Negative power. Ordinary. Expression, equation, identity, formulae, relationship, variable, unknown, substitution, like terms, simplify, change the subject, rearrange. Simultaneous equation, linear, solve. Adjacent, Hypotenuse, Sine, Cosine, Opposite, Tangent, Inverse, trigonometric functions	• End of term assessment • Mid Term marking targets * Establish a rule for how to raise a power of a product, using examples such as (2 × 4)2 and 22 × 42. Then do the same for a power of a division, using, for example (4 ÷ 2)2 and 42 ÷ 22. Try similar exercises with fractions, and with negative powers. * Explore the difference between a negative number raised to a power and a bracketed negative number raised to a power, e.g. –32 and (–3)2. Create more complex expressions to explore BIDMAS further. Try a similar exercise with negative powers. * Create calculations that use BIDMAS, remove the brackets, and ask students to add brackets to the calculations to reach the given answers. * Use the index law for multiplying two powers to find a rule for how to raise a power to another power, e.g. 52 × 52 × 52, and (52)3 * Calculate the thickness of the paper used in different types of books, newspapers and magazines. Discuss what this tells you about them. * For models of objects of different sizes (e.g. famous landmarks, countries, the solar system), express their scales in standard form. * Use the average speed formula to estimate different calculations involving space rockets travelling to other planets, e.g. distance to planet, time taken to reach planet, average speed of rocket. ***** Liaise with the science department to establish when students first meet the use of standard form, and in what contexts they will be expected to interpret it. * Probing questions: Kenny thinks this number is written in standard form: 23×10^7. Do you agree with Kenny? Explain your answer. - When a number 'x' is rounded to 2 significant figures the result is 70. Jenny writes '65 < x < 75'. What is wrong with - - Jenny's statement? How would you correct it? - Convince me that $4.5 \times 10^7 \times 3 \times 10^5 = 1.35 \times 10^{13}$ • Convince me $a^0 = 1$ • What is wrong with this statement: $5^2 \times 5^4 = 5^8$ • Jenny thinks that if y = 2x + 1 then x = (y – 1)/2. Kenny thinks that if y = 2x + 1 then x = y/2 – 1. Who do you agree with? Explain your thinking. • For a ladder of given length, determine whether it will reach a window at a given height at different angles to the ground.

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	• For a tent in the shape of a triangular isosceles prism with some given information, find missing lengths or angles. • Always/ Sometimes/ Never: If $a^2 + b^2 = c^2$, a triangle with sides a, b and c is right angled. • Milly thinks it is possible to use Pythagoras' theorem to find the height of isosceles triangles that are not right- angled. Do you agree with her? Explain your answer. • Show me a Pythagorean Triple. And another. And another. • Convince me a triangle with sides 3, 4, 5 is right-angled but a triangle with sides 4, 5, 6 is not right-angled. • Common Misconceptions: • Confusing index notation and multiplication notation e.g. $3x$ and x^3 • Thinking that indices and roots only apply to integer values • Difficulties manipulating indices and coefficients due to confusing the rules because of a lack of conceptual understanding of the laws of indices • Thinking that e.g. 34×10^2 is in standard form • Lack of understanding of exponential nature of indices leading to difficulties estimating the size of e.g. values in standard form • Lack of understanding of indices (and multiplication) leading to difficulties with surd form such as thinking that $\sqrt{12} = 4\sqrt{3}$ • Insufficient experience and understanding of 'rearrangement' in numerical and solving equations contexts is a barrier to understanding of abstract rearrangement • Some pupils may misapply the order of operation when changing the subject of a formula • Many pupils may think that $a^0 = 0$ • Some pupils may not consider 4ab and 3ba as 'like terms' and therefore will not 'collect' them when simplifying expressions • Some students may use Pythagoras' theorem as though the missing side is always the hypotenuse • Being unable to correctly identify the opposite and adjacent sides given an angle, possibly due to an incomplete definition of adjacent or opposite • Not understanding that ratios can be expressed as divisions and therefore in decimal form

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	• Not realising that corresponding angles in similar triangles are equal

Number Forms	R	A	G
Simplify expressions using index notation			
Write multiples of 10 as a power of 10			
Write big and small numbers in standard form			
Multiply and divide in standard form			

Substitution	R	A	G
Identify an expression, equation and formula			
Substitute values in to an expression or formula			
Solve an equation by trial and improvement			
Solve linear simultaneous equations			
Change the subject of a simple formula			

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Right Angled Triangles	R	A	G
State Pythagoras' Theorem and solve to find the hypotenuse			
Find the shorter side of a triangle using Pythagoras' Theorem			
Use Pythagoras' Theorem in 3D objects			
Know the trigonometric ratios			
Use trigonometry to find a side length			
Use trigonometry to find an angle			