



Mathematics	Working towards expected outcomes	Working at expected outcomes	Working beyond expected outcomes
Autumn Term	<p>Students working <b>towards</b> expected outcomes in Y9 can:</p> <ul style="list-style-type: none"><li>• Use a given trigonometric ratio to find a basic length or angle in a right-angled triangle</li><li>• Find the reciprocal of a positive integer</li><li>• Recall that a value to the power zero is always 1 and that a power of <math>\frac{1}{2}</math> represents a square root</li><li>• Use the three rules of indices with expressions with positive powers and coefficients of 1</li><li>• Use the four rules of operations with large numbers expressed in standard form</li></ul>	<p>Students working <b>at</b> expected in Y9 can:</p> <ul style="list-style-type: none"><li>• Use the three trigonometric ratios to find any length or angle in a basic right-angled triangle</li><li>• Begin to be successful with applications of trigonometry, including multi-step problems, problems involving bearings or angles of elevation/depression</li><li>• Work with problems that involve the correct choice of either trigonometry and/or Pythagoras' theorem</li><li>• Understand the term <b>reciprocal</b> and find this for integer, decimal, fractional and negative values</li><li>• Evaluate zero, negative and fractional indices for integer values</li><li>• Use the three rules of indices, including with cases of positive coefficients</li><li>• Calculate with numbers expressed in standard form and the four operations without a calculator</li></ul>	<p>Students working <b>beyond</b> expected in Y9 can: <b>In addition to the skills listed under Working At for this topic, students working beyond expected outcomes can:</b></p> <ul style="list-style-type: none"><li>• Have success with the full range of two-dimensional problems that require trigonometry and/or Pythagoras' theorem</li><li>• Understand that the three trigonometric ratios represent a relationship between the side lengths of a right-angled triangle and use this knowledge in further questioning</li><li>• Appreciate that zero does not have a reciprocal and explain why not</li><li>• Evaluate complex indices, such as a fractional value to a negative fractional index; work with applied questions and find unknown indices</li><li>• Work with the most complex simplifications with indices, including fractional and negative coefficients or powers</li><li>• Work in a range of contextual problems with numbers in standard form and without a calculator</li></ul>



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| <ul style="list-style-type: none"><li>• Expand three linear brackets with positive terms</li><li>• Factorise basic cases with common factors, double brackets or DOTS and with the method specified</li><li>• Solve <math>x^2 + bx + c = 0</math></li><br/><li>• Complete a given frequency tree to represent information</li><br/><li>• Complete a probability tree and use it to find the change of simple events making use of the AND rule</li><br/><li>• Find percentage change with the formula given</li><li>• Begin to find reverse percentages, particularly in increase situations</li><br/><li>• States the gradient that is either parallel or perpendicular to a given gradient</li><li>• Begins to use <math>y - y_1 = m(x - x_1)</math> but may not be able to recall this</li></ul> | <ul style="list-style-type: none"><li>• Expand three linear brackets</li><li>• Factorise using common factors, double brackets <math>[x^2 \pm bx \pm c]</math> and simple difference of two squares</li><li>• Solve quadratics of the form <math>x^2 \pm bx \pm c = 0</math> [including when <math>c = 0</math>] using factorisation</li><li>• Form basic quadratic equations or “show that” a given quadratic equation represents a given context</li><br/><li>• Create and use a <b>frequency tree</b> to answer a range of probability questions</li><li>• Create and use a <b>probability tree</b> to find the chance of combined events, using both the AND and OR rules</li><br/><li>• Recall and use the formula for percentage change</li><li>• Work with reverse percentages</li><li>• Select the correct percentage method for a given problem</li><br/><li>• Understand how the gradients of perpendicular lines are connected</li><li>• Recall and use <math>y - y_1 = m(x - x_1)</math> to find the equation of a line</li><li>• Work with coordinate geometry problems</li></ul> | <ul style="list-style-type: none"><li>• Expand triple brackets which involve consideration of BIDMAS and/or negatives between two sets of brackets</li><li>• Factorise more complex DOTS and select the correct type(s) of factorising</li><li>• Solve quadratics of the form <math>x^2 \pm bx \pm c = 0</math> [including when <math>c = 0</math>] that may require prior rearranging</li><li>• Derive “Show that” forms for complex situations with quadratics, deciding if a solution in context is plausible</li><br/><li>• Efficiently use a tree diagram, such as recognising that the probability of at least one event is <math>1 -</math> the probability of none at all</li><li>• Work with applied probability questions, such as working in reverse from a combined probability</li><br/><li>• Work with a mix of all percentage techniques [decimal multipliers, percentage change and reverse percentage] and use in applied settings</li><br/><li>• Answer a wide range of coordinate geometry problems, making use of gradient, distance, midpoint and axes intersections knowledge</li></ul> |
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**Spring Term**

Students working **towards** expected outcomes in Y9 can:

- Begin to work with simple upper and lower bounds
- Truncates a value to a given level of accuracy
- Understands that a fraction is a rational number
- Converts simple recurring decimals to fractional form
  
- Substitutes into formulae with positive variable values
- Rearranges simple formulae, particular those with layers that can easily be reversed
  
- Can perform simple reflections (horizontal/vertical lines), rotations, enlargements (positive scale factors) and translations

Students working **at** expected in Y9 can:

- Find the error interval for a number that has been rounded to varying degrees of accuracy
- Truncate a value to given level of accuracy and state the error interval of a truncated value
- Distinguish between ir/rational values
- Uses the prime factor decomposition for the denominator of a simplified fraction to determine if its decimal form is finite/terminating or recurring
- Convert a range of recurring decimals to fractional/rational form
  
- Substitute into a range of formulae with negatives, fractions and decimals and a consideration of BIDMAS
- Rearranges formulae, including those involving either negative or fractional algebraic terms, including with "x" in the denominator
  
- Carry out a reflection, rotation, enlargement or translation from given information, including enlargements with negative scale factors

Students working **beyond** expected in Y9 can:

**In addition to the skills listed under Working At for this topic, students working beyond expected outcomes can:**

- Works with combinations of upper and lower bounds to determine max or min values in applied questioning
- Answer a wide range of problems with recurring decimals needed to be converted first to rational form, linking work on fraction calculations and indices
  
- Selects the most efficient technique for rearranging all formulae in which the required subject appears once; appreciate why different rearrangements are identical, choosing the most eloquent form to display their rearrangement
  
- Works with combinations of and inverse transformations, detecting invariant points in any plane



	<ul style="list-style-type: none"><li>• Begins to describe single transformations</li><li>• Solves simultaneous equations (SE) using elimination, having success with positive terms</li><li>• Identify the solution of a pair of SE from two given linear graphs</li><li>• Set up simple SE to represent a problem</li><li>• Solves simple linear inequalities</li><li>• Shade regions given by horizontal and vertical lines</li><li>• Work with basic surd multiplication and division</li><li>• Finds the nth term of arithmetic sequences and continues simple quadratic and geometric sequences</li><li>• Solves problems with basic Fibonacci style sequences</li></ul>	<ul style="list-style-type: none"><li>• Describe all of the above</li><li>• Carry out a combination of transformations with accuracy</li><li>• Understands invariance and can identify invariant points/properties</li><li>• Solve a range of simultaneous equations (SE) using elimination</li><li>• Begin to solve SE using substitution</li><li>• Solve SE using a graphical approach</li><li>• Use SE to represent real life problems</li><li>• Solve linear inequalities, representing solutions on number lines and identifying integer solutions</li><li>• Shade a region on a graph defined by a set of inequalities</li><li>• Solves inequalities in real settings</li><li>• Work with surds, simplifying these when multiplied or divided (including rewriting integers as surds if needed)</li><li>• Simplify surds to lowest form</li><li>• Generate arithmetic, quadratic, geometric and Fibonacci style sequences</li><li>• Find and work with the nth term of arithmetic and quadratic sequences</li></ul>	<ul style="list-style-type: none"><li>• Uses correct notation for combinations of transformations and inverse transformations</li><li>• Use both elimination and substitution to solve a range of simultaneous linear equations (SE), appreciating the most efficient method to be employed</li><li>• Set up and solve SE to solve a wide range of real life situations, including those involving fractions</li><li>• Solve a combination of inequalities, understanding their joint solution set</li><li>• Reflect on integer points in a given region and decide if they satisfy various conditions</li><li>• Work competently with surds of all forms</li><li>• Derive the nth term formula for a geometric sequence</li><li>• Use algebraic representation in Fibonacci questioning to find later terms, employing simultaneous equations when needed</li></ul>
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<b>Summer Term</b>	<p>Students working <b>towards</b> expected outcomes in Y9 can:</p> <ul style="list-style-type: none"><li>• Work with real life numerical problems that require one or two steps of thinking/planning</li><li>• Uses simple scale factors to find missing lengths in similar shapes, including triangles</li><li>• Begins to plot simple quadratic, cubic, exponential and reciprocal form but may not always appreciate the existence of asymptotes or be precise with negative substitution</li></ul>	<p>Students working <b>at</b> expected in Y9 can:</p> <ul style="list-style-type: none"><li>• Works with a range of real life and unfamiliar problems without a calculator, manipulating ratio, percentages, negatives, fractions and decimals</li><li>• Plans out the steps required to solve a non-calculator numerical problem</li><li>• Understands that similar shapes have lengths that are in proportion and angles that are preserved</li><li>• Use proportion or scale factor to determine if two shapes are similar and to find missing lengths</li><li>• Identify similar triangles, understanding they must have identical angles; uses a formal approach to prove such similarity</li><li>• Appreciate the shape of curved graphs including quadratic, cubic, reciprocal and exponential form</li><li>• Generate, plot and smoothly join points of such forms</li><li>• Appreciate the term asymptote and understand why this exists</li></ul>	<p>Students working <b>beyond</b> expected in Y9 can:</p> <p><b>In addition to the skills listed under Working At for this topic, students working beyond expected outcomes can:</b></p> <ul style="list-style-type: none"><li>• Works competently across all settings and with all types of numerical values</li><li>• Work in unfamiliar settings with similar shapes, including triangles and is comfortable when shapes are not in corresponding orientation</li><li>• Fluently gives an “AAA” argument with clear rule of angles reasoning</li><li>• Uses curved graphs to answer questions regarding <math>x</math> or <math>y</math> values or maximum/minimum points</li></ul>
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- Finds basic perimeter, area, surface area and volumes but cannot always recall formulae
- Use a given formula to find surface area and volume of a sphere
- Use a given formula to find surface area of a cone, but may need support to find the slant height if not given
- Uses a given formula to find the volume of a pyramid
  
- Find mean, median, mode and range from a simple list or frequency table, but may struggle when data is groups
- Begin to find quartiles
- Plot a boxplot when median, quartiles and upper/lower values are given
- Read values from simple boxplots

- Find the perimeter, area, surface area and volume of a variety of shapes, recalling their formulae
- Find the surface area and volume of a sphere and its related solids
- Find the surface area of a cone
- Find the volume of a pyramid
- Convert between units of area or volume, including appreciating that  $1\text{cm}^3 = 1\text{ml}$
- Begin to work with applied problems
  
- Find a mean average from a list, or (grouped) frequency table
- Find the combined mean of two individual data sets
- Find the median, quartiles, range and interquartile range (IQR) of a list of data
- Use data values and quartiles to construct a boxplot
- Read values from a given boxplot
- Compare and contrast two boxplots by using a comparison of a suitable average [median] and measure of spread [range or IQR]

- Work with complex, algebraic and reverse problems with surface area and volume, including those in which units are not initially compatible
  
  - Speculate how outliers will affect measures of average and spread and so select the most appropriate measure to use in a given situation
- Sketch boxplots for skewed, symmetrical or invariant data