

Key Stage 4 Mathematics Programme of Study



Strands	Elements	Year 10	Year 11	Extension
		Learners are able to:	Learners are able to:	Learners are able to:
Developing numerical reasoning	Identify processes and connections	<ul style="list-style-type: none"> transfer mathematical skills across the curriculum in a variety of contexts and everyday situations select, trial and evaluate a variety of possible approaches and break complex problems into a series of tasks prioritise and organise the relevant steps needed to complete the task or reach a solution choose an appropriate mental or written strategy and know when it is appropriate to use a calculator use a scientific calculator to carry out calculations effectively and efficiently using the available range of function keys identify, measure or obtain required information to complete the task identify what further information might be required and select what information is most appropriate select appropriate mathematics and techniques to use estimate and visualise size when measuring and use the correct units develop and evaluate mathematical strategies and ideas creatively ❖ consider connections between mathematical skills and contextualise these ❖ 		
	Represent and communicate	<ul style="list-style-type: none"> explain results and procedures precisely using appropriate mathematical language refine methods of recording calculations use appropriate notation, symbols and units of measurement, including compound measures select and construct appropriate charts, diagrams and graphs with suitable scales interpret graphs that describe real-life situations, including those used in the media, recognising that some graphs may be misleading evaluate different forms of recording and presenting information, taking account of the context and audience ❖ generalise in words, and use algebra, to describe patterns that arise in numerical, spatial or practical situations ❖ 		
	Review	<ul style="list-style-type: none"> select and apply appropriate checking strategies interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible verify and justify results or solutions, including discussion on risk and chance where relevant interpret mathematical information; draw inferences from graphs, diagrams and data, including discussion on limitations of data draw conclusions from data and recognise that some conclusions may be misleading or uncertain recognise that inferences drawn from data may suggest the need for further investigation ❖ justify numerical and algebraic results, making appropriate connections ❖ explain and justify strategies, methods, reasoning and conclusions in a variety of different ways, including orally, graphically, writing (both in mathematical notation and without), using appropriate digital literacy equipment ❖ appreciate the difference between mathematical explanation and experimental evidence; recognise inconsistencies and bias ❖ 		

Key

Within the table, text taken from the LNF will appear as non-bold. Text that has been extended from the LNF or that is a new skill will appear as bold. The text is further identified by the following icons.

Extended skill ▲ **Programme of study skill** ❖

N.B.

In order to comply with accessibility and legibility, these tables have been designed to be printed at their optimum size of A3.



Strands	Elements	Year 10	Year 11	Extension
		Learners are able to:	Learners are able to:	Learners are able to:
Using number skills	Use number facts and relationships	<ul style="list-style-type: none"> use and interpret numbers in standard form within calculations convert to and from standard form ❖ find the lowest common multiples and highest common factor using prime factors ❖ 	<ul style="list-style-type: none"> identify when to use standard form ❖ 	<ul style="list-style-type: none"> manipulate surds ❖ distinguish between rational and irrational numbers ❖
	Fractions, decimals, percentages and ratio	<ul style="list-style-type: none"> use multipliers as an efficient method when working with percentages, e.g. <i>multiply by 1.2 to increase an amount by 20%</i> calculate the outcome of a given repeated proportional change ❖ calculate with direct and inverse proportion ❖ use calculations with different representations of fractions ❖ 	<ul style="list-style-type: none"> use and understand the idea of reverse percentage to find an original quantity use powers to calculate the outcome of a given repeated proportional change ❖ use direct and inverse proportion ❖ 	<ul style="list-style-type: none"> use and understand ratio and proportion in 2 and 3 dimensions ▲ change between recurring decimals and fractions ❖
	Calculate using mental and written methods	<ul style="list-style-type: none"> select, choose and justify selection of method, including when to use a calculator ❖ use negative numbers ❖ 	<ul style="list-style-type: none"> select, choose and justify selection of method, including when to use a calculator ❖ 	
	Estimate and check	<ul style="list-style-type: none"> define upper and lower bounds of a number that has been given to a specified degree of accuracy ❖ 	<ul style="list-style-type: none"> recognise and define limitations on accuracy of measurements in calculations involving addition and subtraction ▲ explore the impact of premature rounding ❖ 	<ul style="list-style-type: none"> recognise and define limitations on accuracy of measurements in calculations involving the four operations ▲

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		Learners are able to:	Learners are able to:	Learners are able to:	
Using number skills	Manage money	<ul style="list-style-type: none"> understand and demonstrate the real-life process of foreign exchange consider best value of an item priced in two or more different currencies ❖ calculate compound interest ❖ make comparisons between financial products that involve short-term borrowing and investments ❖ calculate with money, including household bills ❖ make informed decisions relating to household budgeting ❖ understand and calculate income tax 	<ul style="list-style-type: none"> use and understand efficient methods of calculating compound interest make comparisons between financial products that involve long-term borrowing and investments ❖ 		
	Length, weight/mass, capacity	<ul style="list-style-type: none"> find the perimeter of semicircles and quarter circles, including compound shapes ❖ use Pythagoras' theorem ❖ calculate the length of a side in a right angled triangle using trigonometry ❖ understand and use a variety of compound measures, including speed, density and population density ▲ convert between metric units of area ❖ convert between metric units of volume ❖ construct and interpolate from conversion graphs ❖ define upper and lower bounds of a measurement that has been given to a specified degree of accuracy ❖ 	<ul style="list-style-type: none"> find the arc length ❖ find the perimeter of a sector ❖ use trigonometry to find the length of a side in a right angled triangle, e.g. finding the height of an isosceles triangle ❖ understand and use a variety of compound measures that involve converting between units ▲ construct and extrapolate from conversion graphs ❖ recognise and define limitations on accuracy of measurements in calculations involving addition and subtraction ❖ 	<ul style="list-style-type: none"> find the perimeter of a segment ❖ use trigonometry in non-right angled triangles ❖ use Pythagoras' theorem and trigonometry in 3 dimensions ❖ use the sine and cosine rule ❖ recognise and define limitations on accuracy of measurements in calculations involving the four operations ❖ 	
		Time	<ul style="list-style-type: none"> use timetables and time zones to plan a multi-stage journey ❖ plan the optimum route from a selection of timetables ❖ 		
		Temperature			



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		Learners are able to:	Learners are able to:	Learners are able to:
Using measuring skills	Area and volume Angle and position	<ul style="list-style-type: none"> • apply proportional change to 2-dimensional designs • find areas of halves and quarters of circles, including cases that require a solution expressed in terms of pi ❖ • calculate volumes of prisms and cylinders ❖ • find the distance between two points from their coordinates ❖ • find the midpoint of a line ❖ • find locations given sets of bearings and/or distances ❖ • calculate an angle in a right angled triangle using trigonometry ❖ 	<ul style="list-style-type: none"> • find surface areas of prisms, cylinders and spheres ❖ • calculate sector area ❖ • distinguish between formulae for length, area and volume, and check that a formula is dimensionally correct ❖ • calculate volumes of spheres, hemispheres, cones and pyramids ❖ • use coordinates in 3 dimensions ❖ • use circle theorems to calculate angles in circles ❖ • use trigonometry in situations including those involving bearings, angles of elevation and depression ❖ 	<ul style="list-style-type: none"> • calculate segment area ❖ • calculate the surface area of cones ❖ • calculate volumes of compound solids ❖ • use the alternate segment theorem ❖ • understand and construct geometrical proofs using circle theorems ❖ • sketch and use trigonometric graphs ❖ • use trigonometry in non-right angled triangles ❖ • use the sine and cosine rule ❖ • use trigonometry to find an angle in 3 dimensions ❖
	Using geometry skills	Shape	<ul style="list-style-type: none"> • recognise similar shapes and calculate the size of missing sides ❖ • use the terms arc, sector, segment, chord, tangent ❖ 	<ul style="list-style-type: none"> • find the area of a 2D shape given the area of a similar shape and a pair of corresponding sides ❖ • find the volume of a similar shape given the volume of a similar shape and a pair of corresponding edges ❖
	Construction	<ul style="list-style-type: none"> • draw plans and elevations of any 3D solid ❖ • construct perpendicular bisectors, the perpendicular from a point to a line, angles of 60° and 90° and the bisector of an angle ❖ • shade a region defined by up to two conditions ❖ 	<ul style="list-style-type: none"> • draw accurate plans and elevations of any 3D solid to an appropriate scale ❖ • select and apply loci to solve problems given more than two conditions ❖ 	



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Using geometry skills	Movement	<ul style="list-style-type: none"> translate a shape by a vector ❖ describe a translation using vectors ❖ reflect shapes in horizontal and vertical lines ❖ describe reflection in horizontal or vertical lines ❖ rotate shapes about a point ❖ describe rotations and find the centre of rotation ❖ enlarge a shape from a centre where the scale factor is 0.5 ❖ 	<ul style="list-style-type: none"> reflect shapes in the lines $y = x$ and $y = -x$ ❖ enlarge a shape from a centre where the scale factor is a fraction ❖ find the centre of enlargement ❖ recognise and describe transformations ❖ 	<ul style="list-style-type: none"> enlarge a shape from a centre with a negative scale factor ❖ recognise and describe combinations of transformations ❖
	Number sequences	<ul style="list-style-type: none"> recognise a non-linear sequence ❖ generate non-linear sequences given the position to term rule ❖ 	<ul style="list-style-type: none"> express position to term rules algebraically, e.g. $n^2, n^2 + 1, n^2 + 3, n^2 - 3, n^3$ ❖ 	<ul style="list-style-type: none"> generate complex non-linear sequences given the position to term rule ❖ express position to term rules algebraically, e.g. $2n^2 + 6, (n + a)^2, an^2 + bn + c$ where a is not equal to 0 ❖
Using algebra skills	Expressions and formulae	<ul style="list-style-type: none"> manipulate indices, e.g. $(2a^2)^3$ ❖ show and use rules of indices where the power is 0 or a fraction with numerator 1 ❖ substitute into a variety of expressions, including those involving powers and brackets ❖ factorise algebraic expressions of two or more terms into a single bracket, including those where there is more than one common factor ❖ rearrange formulae including whole number powers and brackets ❖ 	<ul style="list-style-type: none"> show and use indices rules where the power is a negative whole number or a proper fraction ❖ recognise situations that require substitution, e.g. <i>drawing graphs</i> ❖ multiply out double brackets ❖ factorise quadratic expressions of the type $x^2 + 3x$ ❖ factorise quadratic expressions where the coefficient of x^2 is 1, including the difference of two squares ❖ rearrange formulae involving brackets and powers ❖ 	<ul style="list-style-type: none"> rearrange formulae, including cases that require factorisation ❖ simplify algebraic fractions ❖ show and use indices rules where the power is a negative fraction or the base is a positive fraction ❖ factorise quadratic expressions ❖



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		Learners are able to:	Learners are able to:	Learners are able to:
Using algebra skills	Functions and graphs	<ul style="list-style-type: none"> find the equation of a line from a graph ❖ generate and plot points for simple quadratic and cubic functions ❖ solve simple linear simultaneous equations graphically ❖ construct graphs and define regions to show one inequality $<$ $>$ \leq \geq ❖ 	<ul style="list-style-type: none"> state the equation of parallel and perpendicular lines given facts or a graph ❖ generate and plot points for simple reciprocal graphs ❖ solve linear simultaneous equations by graphing ❖ identify key features of, and distinguish between, graphs of linear, quadratic, cubic and reciprocal functions ❖ construct graphs and define regions to show 2 or more inequalities ❖ 	<ul style="list-style-type: none"> generate and plot points for simultaneous equations including one non-linear ❖ generate and plot points of a circle ❖ construct or define regions given by 3 or more inequalities ❖ transform graphs of functions ❖ use exponential graphs ❖
	Equations and inequalities	<ul style="list-style-type: none"> solve equations by trial and improvement and justify the solution ❖ solve simple linear simultaneous equations ❖ draw inferences from distance–time graphs ❖ 	<ul style="list-style-type: none"> solve linear simultaneous equations ❖ solve a quadratic equation where the coefficient of x^2 is 1 by factorising ❖ examine rates of change, e.g. <i>vases and water</i> ❖ 	<ul style="list-style-type: none"> construct and solve equations involving direct and inverse proportion, algebraically or otherwise ❖ solve simultaneous equations ❖ solve quadratic equations by selection of an appropriate method ❖ find the distance travelled from speed–time graphs ❖ construct tangents to curves and interpret their gradients ❖ interpret the meaning of the area under a graph ❖



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Using data skills	Collect and record data Present and analyse data Interpret results	<ul style="list-style-type: none"> specify and test hypotheses, taking account of sampling ❖ identify possible sources of bias in the design of collection sheets and questionnaires ❖ evaluate questionnaires and write suitable questions, including response boxes ❖ construct and interpret graphs and diagrams (including pie charts) to represent discrete or continuous data, with the learner choosing the most appropriate representation, including frequency polygons and lines of best fit on scatter diagrams ❖ calculate the upper quartile, lower quartile and interquartile range of a set of discrete data and use them to describe a data set ❖ use a scatter diagram to make predictions about the data from a line of best fit drawn by eye ❖ understand the effects of extrapolation and interpolation on reliability ❖ find the mean, median, mode and range from grouped frequency tables and explain why it is an estimate ❖ 	<ul style="list-style-type: none"> specify and test hypotheses, taking account of the limitations of the data ❖ consider the effect of sample size and other factors that affect the reliability of conclusions drawn ❖ sample systematically ❖ construct and interpret graphs and diagrams (including pie charts) to represent discrete or continuous data, with the learner choosing the most appropriate representation including cumulative frequency curves ❖ use a scatter diagram to make predictions about the data from a line of best fit that passes through the mean ❖ use a cumulative frequency curve to estimate the median, quartiles and interquartile range ❖ use the interquartile range to compare distributions ❖ compare sets of data and their distributions, using appropriate methods, including those that involve describing central tendency, dispersion, correlation ❖ recognise and use the most appropriate data to compare distributions ❖ 	<ul style="list-style-type: none"> work with stratified sampling techniques ❖ define a random sample ❖ construct and interpret graphs and diagrams (including pie charts) to represent discrete or continuous data, with the learner choosing the most appropriate representation including histograms with unequal class widths ❖ compare sets of data and their distributions, using appropriate methods, including those that involve describing central tendency, dispersion, correlation ❖ recognise and use the most appropriate data to compare distributions ❖



		←	Year 10	↔	Year 11	↔	Extension
Strands	Elements		Learners are able to:		Learners are able to:		Learners are able to:
Using data skills	Probability		<ul style="list-style-type: none"> • know that the sum of probabilities is 1 and use this to find missing probabilities in fraction or decimal form, including where there are two equal probabilities missing ❖ • understand that reliability/stability increases with a greater number of trials ❖ • compare an estimated probability from experimental results with a theoretical probability ❖ • identify when to construct sample space diagrams or two way tables to solve a problem ❖ • use a two way table and sample space diagram to calculate the probability of simple compound events ❖ • use a two way table to calculate simple cases of x given y, e.g. <i>find the probability that a girl travels by bus</i> ❖ • estimate the number of successes where probability is expressed as a fraction or decimal. ❖ 		<ul style="list-style-type: none"> • understand dependent and independent outcomes ❖ • use relative frequency to test a given probability ❖ • complete a tree diagram for two or more independent events ❖ • use tree diagrams to calculate the probability of combined events. ❖ 		<ul style="list-style-type: none"> • construct and use a tree diagram for two or more dependent events. ❖