

# Curriculum for Wales



Llywodraeth Cymru  
Welsh Government

## Programme of Study for Mathematics

Key Stages 2–4

# Curriculum for Wales: Programme of Study for Mathematics, Key Stages 2–4

## Audience

Teachers, headteachers and governing bodies of maintained schools in Wales; local authorities; regional consortia; initial teacher training providers; teacher unions and school representative bodies; church diocesan authorities; national bodies in Wales with an interest in education.

## Overview

This document sets out the Welsh Government's requirements for mathematics in the national curriculum for Wales. It is issued pursuant to the powers contained in section 108 of the Education Act 2002 and which are vested in the Welsh Ministers. The Welsh Ministers form part of the Welsh Government.

## Action required

Teachers, headteachers and governing bodies of maintained schools must ensure that the legal requirements set out in this document are implemented in line with the dates specified in the foreword.

## Further information

Enquiries about this document should be directed to:

Curriculum Division  
Department for Education and Skills  
Welsh Government  
Cathays Park  
Cardiff  
CF10 3NQ  
e-mail: [curriculumdivision@wales.gsi.gov.uk](mailto:curriculumdivision@wales.gsi.gov.uk)

## Additional copies

This document can be accessed from the Welsh Government's Learning Wales website at [www.gov.wales/learning](http://www.gov.wales/learning)

## Related documents

*Curriculum for Wales: Programme of Study for English, Key Stages 2–4* (2016); *Curriculum for Wales: Programme of Study for Welsh, Key Stages 2–4* (2016).

# Contents

<b>Foreword</b>	<b>1</b>
<b>Key Stage 2 Programme of Study</b>	<b>2</b>
National curriculum outcomes	2
National curriculum level descriptions	15
<b>Key Stage 3 Programme of Study</b>	<b>18</b>
National curriculum outcomes	28
National curriculum level descriptions	29
<b>Key Stage 4 Programme of Study</b>	<b>32</b>

# Foreword

This document sets out the national curriculum for **mathematics** in Wales.

## The structure of the national curriculum

The national curriculum applies to learners of compulsory school age in maintained schools. It is organised on the basis of three key stages, which are broadly as follows\*.

	Learners' ages	Year groups
Key Stage 2	7–11	3–6
Key Stage 3	11–14	7–9
Key Stage 4	14–16	10–11

In Wales, the following subjects are included in the national curriculum at the key stages shown.

Key Stage 2	English, Welsh, Welsh second language, mathematics, science, design and technology, information and communication technology, history, geography, art and design, music and physical education.
Key Stage 3	As at Key Stage 2, plus a modern foreign language.
Key Stage 4	English, Welsh, Welsh second language, mathematics, science and physical education.

For each subject, in each of the key stages listed above, programmes of study set out what learners should be taught.

At the end of Key Stages 2 and 3, standards of learners' performance are set out in eight level descriptions of increasing difficulty, with an additional description above Level 8 to help teachers in differentiating Exceptional Performance.

At Key Stage 4, external qualifications are the main means of assessing attainment in the national curriculum. The Database for Approved Qualifications for Wales (DAQW) includes all qualifications that Welsh Government has approved, under section 96 of the Learning and Skills Act 2000, for use with learners of compulsory school age.

## Implementation dates

The revised programmes of study for **mathematics** become legal requirements by means of an Order made by the Welsh Government and come into effect on 1 September 2015.

From this date the existing national curriculum for **mathematics** is superseded.

## Welsh Government August 2015

\* The key stages are defined precisely in section 103 of the Education Act 2002.

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	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"> <li>transfer mathematical skills to a variety of contexts and everyday situations</li> <li>identify the appropriate steps and information needed to complete the task or reach a solution</li> <li>select appropriate mathematics and techniques to use</li> <li>select and use suitable instruments and units of measurement</li> <li>choose an appropriate mental or written strategy and know when it is appropriate to use a calculator</li> <li>estimate and visualise size when measuring and use the correct units</li> </ul>			
	Represent and communicate	<ul style="list-style-type: none"> <li>explain results and procedures clearly using mathematical language</li> <li>refine informal methods of recording written calculations, moving to formal methods of calculation when developmentally ready</li> <li>use appropriate notation, symbols and units of measurement</li> <li>select and construct appropriate charts, diagrams and graphs with suitable scales</li> <li><b>recognise, and generalise in words, patterns that arise in numerical, spatial or practical situations</b> ❖</li> <li><b>visualise and describe shapes, movements and transformations</b> ❖</li> </ul>			
	Review	<ul style="list-style-type: none"> <li>select from an increasing range of checking strategies to decide if answers are reasonable</li> <li>interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible</li> <li>draw conclusions from data and recognise that some conclusions may be misleading or uncertain</li> </ul>			

## 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 specific Mathematics Programme of Study skill will appear as bold. These skills are further identified by the following icons.

**Extended skill** ▲ **Programme of study skill** ❖ When combined with the LNF statements, these skills form the Key Stage 2 Mathematics Programme of Study.

## N.B.

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

# Key Stage 2 Mathematics Programme of Study



		← Year 3	↔ Year 4	↔ Year 5	← Year 6 →
Strands	Elements	Learners are able to:	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"> <li>• read and write numbers to 1 000</li> <li>• compare and estimate with numbers up to 100</li> <li>• <b>explain the value of a digit in numbers up to 1 000</b> ❖</li> <li>• use mental strategies to recall number facts within 20</li> <li>• recall 2, 3, 4, 5 and 10 multiplication tables and use to solve multiplication and division problems</li> <li>• multiply numbers by 10</li> <li>• <b>identify multiples of 2, 3, 4, 5 and 10; use the term multiple</b> ❖</li> <li>• <b>identify odd and even numbers up to 1 000</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>• read and write numbers to 10 000</li> <li>• compare and estimate with numbers up to 1 000</li> <li>• use mental strategies to recall multiplication tables for 2, 3, 4, 5, 6 and 10 and use to solve division problems</li> <li>• multiply and divide numbers by 10 and 100</li> <li>• <b>identify multiples of 2, 3, 4, 5, 6 and 10; use the terms multiple and factor</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>• read and write numbers to 100 000</li> <li>• compare numbers with 1 and 2 decimal places</li> <li>• use mental strategies to recall multiplication tables for 2, 3, 4, 5, 6, 8 and 10 and use to solve division problems</li> <li>• multiply and divide numbers and decimals by 10 and 100</li> <li>• <b>identify multiples of 2, 3, 4, 5, 6, 8 and 10; use the terms multiple and factor</b> ❖</li> <li>• <b>identify prime numbers as having only two factors; recognise that 1 is not a prime number</b> ❖</li> <li>• <b>identify prime numbers below 10</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>• read and write numbers to 1 million and numbers to 3 decimal places</li> <li>• use mental strategies to recall multiplication tables up to 10 x 10 and use to solve division problems</li> <li>• multiply numbers and decimals by a multiple of 10, e.g. <math>15 \times 30</math>, <math>1.4\text{cm} \times 20</math></li> <li>• <b>identify multiples of numbers up to 10; use the terms multiple and factor</b> ❖</li> <li>• <b>identify common multiples of two numbers</b> ❖</li> <li>• <b>identify common factors of two numbers</b> ❖</li> <li>• <b>identify prime numbers</b> ❖</li> <li>• <b>know prime numbers below 20</b> ❖</li> </ul>

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	Learners are able to:	Learners are able to:	Learners are able to:
Using number skills	Fractions, decimals, percentages and ratio	<ul style="list-style-type: none"> <li>• use halves and quarters</li> <li>• halve 2-digit numbers in the context of number, money and measures</li> <li>• find fractional quantities linked to known multiplication facts, e.g. <math>\frac{1}{3}</math> of 18, <math>\frac{1}{5}</math> of 15</li> <li>• <b>recognise a quarter as a half</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>• halve 3-digit numbers in the context of number, money and measures</li> <li>• find fractional quantities using known table facts, e.g. <math>\frac{1}{6}</math> of 30cm</li> <li>• recognise fractions that are several parts of a whole, e.g. <math>\frac{2}{3}</math>, <math>\frac{3}{10}</math></li> </ul>	<ul style="list-style-type: none"> <li>• use understanding of simple fraction and decimal equivalences when measuring and calculating, e.g. <math>\frac{1}{2} = 0.5</math>, <math>\frac{1}{10} = 0.1</math></li> <li>• calculate fractional quantities, e.g. <math>\frac{1}{8}</math> of 24 = 3, so <math>\frac{5}{8}</math> of 24 = 15</li> <li>• use doubling and halving strategies when working with simple proportions</li> <li>• <b>share objects in a given ratio, e.g. red blocks and blue blocks in a ratio of 1:2</b> ❖</li> <li>• recognise connections between fractions, e.g. <i>one-tenth is half of one-fifth</i> ❖</li> <li>• add and subtract fractions with the same denominator ❖</li> <li>• add fractions with the same denominator to make a whole ❖</li> </ul>	<ul style="list-style-type: none"> <li>• use understanding of simple fraction, decimal and percentage equivalences, e.g. <i>find 25% of 60cm and know that this is equivalent to <math>\frac{1}{4}</math> of 60cm</i></li> <li>• calculate percentage quantities based on 10%, e.g. 20%, 5%, 15%</li> <li>• use simple ratio and proportion</li> <li>• <b>use ratio to express two or more quantities in words</b> ❖</li> <li>• <b>state the proportion of a whole that each share represents, e.g. recognise that in a ratio of 1:3, 1 part represents a quarter of the total</b> ❖</li> <li>• find equivalent fractions and use these to add and subtract fractions ❖</li> <li>• simplify fractions ❖</li> </ul>

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	Learners are able to:	Learners are able to:	Learners are able to:
Using number skills	Calculate using mental and written methods	<ul style="list-style-type: none"> <li>find differences within 100</li> <li>use mental strategies to add and subtract 2-digit numbers</li> <li>use partitioning to double and halve 2-digit numbers</li> <li><b>define a negative number as being less than 0</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>find differences within 1 000</li> <li>add a 2-digit number to, and subtract a 2-digit number from, a 3-digit number using an appropriate mental or written method</li> <li>use mental strategies to multiply and divide 2-digit numbers by a single digit number</li> <li><b>identify negative whole numbers on a number line</b> ❖</li> <li><b>order whole numbers between -10 and 10</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>find differences between numbers with 1 decimal place</li> <li>add and subtract 3-digit numbers using an appropriate mental or written method</li> <li>multiply and divide 3-digit numbers by a single-digit number</li> <li><b>order negative and positive numbers, including decimals to 1 decimal place</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>add and subtract numbers using whole numbers and decimals</li> <li>multiply 2- and 3-digit numbers by a 2-digit number</li> <li>divide 3-digit numbers by a 2-digit number</li> <li><b>add or subtract across zero using a number line, e.g. <math>-3 + 5</math>, <math>4 - 6</math></b> ❖</li> </ul>
	Estimate and check	<ul style="list-style-type: none"> <li>check subtraction using addition</li> <li>check halving using doubling</li> <li>check multiplication using repeated addition</li> </ul>	<ul style="list-style-type: none"> <li>check answers using inverse operations</li> <li>estimate by rounding to the nearest 10 or 100</li> </ul>	<ul style="list-style-type: none"> <li>check answers using inverse operations</li> <li>estimate by rounding to the nearest 10, 100 or 1 000</li> </ul>	<ul style="list-style-type: none"> <li>check answers using inverse operations</li> <li>estimate by rounding to the nearest 10, 100, 1 000 or whole number</li> </ul>
	Manage money	<ul style="list-style-type: none"> <li>use different combinations of money to pay for items up to £2 and calculate the change</li> <li>order and compare items up to £10</li> <li>record money spent and saved</li> </ul>	<ul style="list-style-type: none"> <li>use money to pay for items up to £10 and calculate the change</li> <li>order and compare items up to £100</li> <li>add and subtract totals less than £10 using correct notation, e.g. <math>£6.85 - £2.76</math></li> <li>manage money, compare costs from different retailers and determine what can be bought within a given budget</li> </ul>	<ul style="list-style-type: none"> <li>order and compare the cost of items up to £1 000</li> <li>add and subtract totals less than £100 using correct notation, e.g. <math>£28.18 + £33.45</math></li> <li>plan and track money and savings by keeping accurate records</li> <li>realise that budgeting is important</li> </ul>	<ul style="list-style-type: none"> <li>use the terms profit and loss in buying and selling activities and make calculations for this</li> <li>understand the advantages and disadvantages of using bank accounts</li> <li>make comparisons between prices and understand which is best value for money</li> </ul>

# Key Stage 2 Mathematics Programme of Study



		←	Year 3	↔	Year 4	↔	Year 5	↔	Year 6	→
Strands	Elements		Learners are able to:		Learners are able to:		Learners are able to:		Learners are able to:	
Using measuring skills	Length, weight/mass, capacity		<ul style="list-style-type: none"> <li>recognise that perimeter is the distance around a shape</li> <li>use standard units <b>to estimate and measure</b>:                             <ul style="list-style-type: none"> <li>length: measure on a ruler to the nearest <math>\frac{1}{2}</math> cm</li> <li>weight/mass: use 5g, 10g and 100g weights</li> <li>capacity: use litres and half litres; measure to the nearest 100ml ▲</li> </ul> </li> <li><b>choose between metric units to measure a length</b> ❖</li> </ul>		<ul style="list-style-type: none"> <li>measure and calculate the perimeter of squares and rectangles</li> <li><b>select and use appropriate standard units to estimate and measure length, weight/mass and capacity</b> ❖</li> <li>measure on a ruler to the nearest mm and record using a mix of units, e.g. <i>1cm 3mm</i></li> <li>use weighing scales with divisions to weigh objects to the nearest 5g, 10g, 25g or 100g</li> <li>measure capacities to the nearest 50ml or 100ml</li> <li>convert metric units of length to smaller units, e.g. <i>cm to mm, m to cm, km to m</i></li> <li><b>choose appropriate metric units to measure length, weight/mass and capacity</b> ❖</li> </ul>		<ul style="list-style-type: none"> <li>measure and calculate perimeters</li> <li><b>make estimates of length, weight/mass and capacity based on knowledge of the size of real-life objects</b> ❖</li> <li>use measuring instruments with 10 equal divisions between each major unit, and record using decimal notation, e.g. <i>4.2cm, 1.3kg</i></li> <li>make use of conversions, e.g. <i><math>\frac{1}{4}</math> of a km = 250m</i></li> <li><b>recognise the appropriateness of units in different contexts</b> ❖</li> </ul>		<ul style="list-style-type: none"> <li>read and interpret scales or divisions on a range of measuring instruments</li> <li><b>make estimates of length, weight/mass and capacity based on knowledge of the size of real-life objects, recognising the appropriateness of units in different contexts</b> ❖</li> <li>record measurements in different ways, e.g. <i>1.3kg = 1kg 300g</i></li> <li>use the language of imperial units in daily use, e.g. <i>miles, pints</i></li> </ul>	

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	Learners are able to:	Learners are able to:	Learners are able to:
Using measuring skills	Time	<ul style="list-style-type: none"> <li>tell the time to the nearest 5 minutes on an analogue clock and calculate how long it is to the next hour</li> <li>read hours and minutes on a 12-hour digital clock using am/pm conventions</li> <li><b>calculate start times, finish times and durations using hours, 30-minute intervals and 15-minute intervals</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>tell the time to the nearest minute on analogue clocks</li> <li>read hours and minutes on a 24-hour digital clock</li> <li>time and order events in seconds</li> <li>use calendars to plan events</li> <li><b>calculate start times, finish times and durations using 5-minute intervals</b> ❖</li> <li><b>convert between 12- and 24-hour clock times</b> ❖</li> <li><b>estimate the number of minutes everyday activities take to complete</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>read and use analogue and digital clocks</li> <li>time events in minutes and seconds, and order the results</li> <li><b>calculate start times, finish times and durations using hours and minutes</b> ❖</li> <li>carry out practical activities involving timed events and explain which unit of time is the most appropriate</li> <li><b>estimate the length of time everyday activities take to complete, extending to hours and quarters of hours</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>use and interpret timetables and schedules to plan events and activities and make calculations as part of the planning process</li> <li>estimate how long a journey takes</li> <li>time events in minutes and seconds to the nearest tenth of a second</li> <li><b>convert between standard units of time</b> ❖</li> <li><b>estimate the length of time everyday activities take to complete with increasing accuracy</b> ❖</li> </ul>
	Temperature	<ul style="list-style-type: none"> <li>take temperature readings using thermometers and interpret readings above and below 0°C</li> </ul>	<ul style="list-style-type: none"> <li>take temperature readings using thermometers and interpret readings above and below 0°C</li> </ul>	<ul style="list-style-type: none"> <li>measure and record temperatures involving positive and negative readings</li> <li>calculate temperature differences, including those involving temperature rise and fall across 0°C</li> </ul>	<ul style="list-style-type: none"> <li>measure and record temperatures involving positive and negative readings</li> <li>calculate temperature differences, including those involving temperature rise and fall across 0°C</li> </ul>

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	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"> <li>find areas by counting squares</li> <li><b>identify right angles</b> ❖</li> <li><b>recognise that two right angles make a half turn, and that four right angles make a full turn</b> ❖</li> <li><b>describe an angle as more or less than a right angle</b> ❖</li> <li>use the four compass points to describe directions</li> </ul>	<ul style="list-style-type: none"> <li>recognise volume in practical contexts</li> <li><b>use a protractor to check if an angle is more or less than a right angle</b> ❖</li> <li>use eight compass points to describe direction</li> </ul>	<ul style="list-style-type: none"> <li>calculate, estimate and compare the area of squares and rectangles using standard units</li> <li>find volumes by counting and other practical methods</li> <li><b>recognise acute and obtuse angles</b> ❖</li> <li><b>draw and measure acute angles in multiples of 10 degrees</b> ❖</li> <li>use coordinates to specify location</li> </ul>	<ul style="list-style-type: none"> <li>calculate the area of squares and rectangles</li> <li><b>recognise reflex angles</b> ❖</li> <li><b>draw accurately and measure acute and obtuse angles in multiples of 5 degrees</b> ❖</li> <li><b>calculate a missing angle within a right angle, on a straight line or around a point</b> ❖</li> <li>use grid references to specify location</li> </ul>
Using geometry skills	Shape	<ul style="list-style-type: none"> <li><b>recognise and classify triangles, squares, rectangles, pentagons and hexagons, including irregular cases</b> ❖</li> <li><b>identify congruent shapes</b> ❖</li> <li><b>recognise 3D shapes, including prisms</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li><b>recognise, classify and sketch polygons with up to eight sides, including irregular shapes</b> ❖</li> <li><b>recognise and classify 3D shapes, using their own criteria</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li><b>recognise and classify triangles, using their own criteria</b> ❖</li> <li><b>identify congruent shapes and justify whether two or more shapes are congruent</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li><b>recognise tetrahedra and square based pyramids</b> ❖</li> <li><b>recognise and sketch different types of quadrilaterals</b> ❖</li> <li><b>explore the tessellation of different shapes</b> ❖</li> <li><b>identify a net of a cube</b> ❖</li> </ul>

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	Learners are able to:	Learners are able to:	Learners are able to:
Using geometry skills	Construction	<ul style="list-style-type: none"> <li>draw lines to the nearest half centimetre ❖</li> </ul>	<ul style="list-style-type: none"> <li>draw lines to the nearest millimetre ❖</li> <li>recognise and draw perpendicular and parallel lines ❖</li> </ul>	<ul style="list-style-type: none"> <li>draw and label lines accurately, e.g. <math>AB</math> ❖</li> <li>draw squares, rectangles and right angled triangles accurately ❖</li> <li>construct solids from given nets ❖</li> </ul>	<ul style="list-style-type: none"> <li>draw cubes and cuboids on isometric paper ❖</li> <li>draw nets of cubes on square paper ❖</li> </ul>
	Movement	<ul style="list-style-type: none"> <li>identify lines of symmetry in 2D shapes ❖</li> <li>draw horizontal and vertical lines of symmetry ❖</li> </ul>	<ul style="list-style-type: none"> <li>draw lines of symmetry ❖</li> <li>draw the reflection of a shape in a horizontal or vertical line ❖</li> </ul>	<ul style="list-style-type: none"> <li>draw the reflection of a shape in any line ❖</li> <li>complete a partly drawn shape after rotation ❖</li> <li>translate a shape on squared paper horizontally or vertically ❖</li> </ul>	<ul style="list-style-type: none"> <li>find all the lines of symmetry for a given shape ❖</li> <li>identify rotational symmetry of shapes ❖</li> <li>identify symmetrical properties of regular polygons ❖</li> </ul>
Using algebra skills	Number sequences	<ul style="list-style-type: none"> <li>explore sequences of whole numbers involving addition and subtraction, e.g. <i>counting in 2s, 3s and 4s from different starting points</i> ❖</li> <li>write the next two (or more) terms in sequences that involve addition or subtraction ❖</li> </ul>	<ul style="list-style-type: none"> <li>explore sequences of positive whole numbers involving addition and subtraction in 2s, 3s, 4s, 5s, 6s, 8s and 10s from different starting points ❖</li> <li>write the next two (or more) terms in sequences that involve addition or subtraction ❖</li> </ul>	<ul style="list-style-type: none"> <li>recognise and state the difference in sequences that involve adding or subtracting ❖</li> <li>write the next two (or more) terms in sequences ❖</li> <li>show that a number is in the sequence and/or find the position number by continuing the sequence or otherwise ❖</li> </ul>	<ul style="list-style-type: none"> <li>find the term to term rule for ascending and descending sequences, e.g. <i>3, 7, 11, 15 add 4</i> ❖</li> <li>generate a sequence given the first term and the term to term rule ❖</li> <li>consider spatial patterns, e.g. <i>square numbers</i> ❖</li> </ul>

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	Learners are able to:	Learners are able to:	Learners are able to:
Using algebra skills	Expressions and formulae				<ul style="list-style-type: none"> <li>explore general statements through practical activities, e.g. that <math>a + a + a = 3a</math>, <math>3 \times a = 3a</math> and <math>a + a + a + b + b = 3a + 2b</math> ❖</li> <li>simplify expressions involving the addition of one variable, e.g. <math>5t + 3t = 8t</math> ❖</li> </ul>
	Functions and graphs	<ul style="list-style-type: none"> <li>use one and two step function machines to generate input and output involving addition and subtraction within 100; express, in words, the operations of function machines ❖</li> </ul>	<ul style="list-style-type: none"> <li>use one and two step function machines to generate input and output using all four operations; express, in words, the operations of function machines ❖</li> </ul>	<ul style="list-style-type: none"> <li>use multistep function machines to generate input and output using all four operations; express, in words, the operations of function machines ❖</li> <li>read, plot and write coordinates in one quadrant, e.g. (2, 4) ❖</li> </ul>	<ul style="list-style-type: none"> <li>express output generated from one step function machines using algebra ❖</li> <li>identify the coordinates of a missing point from a regular shape ❖</li> <li>refer to the x axis and the y axis ❖</li> </ul>
	Equations and inequalities	<ul style="list-style-type: none"> <li>find an 'unknown' in one step equations and use this to derive other facts, e.g. <math>37 + \square = 100</math> therefore <math>100 - 37 = \square</math> ❖</li> <li>list numbers that are 'greater than' or 'less than' another number ❖</li> <li>read statements about numbers expressed using an inequality sign, e.g. <math>6 &gt; 4</math> ❖</li> </ul>	<ul style="list-style-type: none"> <li>use <math>&lt; &gt;</math> to describe whether a number is less than or greater than another ❖</li> <li>find an 'unknown' in two step equations, e.g. <math>4 \times \square + 1 = 25</math> ❖</li> </ul>	<ul style="list-style-type: none"> <li>solve one step equations using letters to present 'unknowns' with integer solutions, e.g. <math>6 + a = 10</math> and <math>b + b = 8</math> ❖</li> <li>use <math>&lt; &gt;</math> to describe whether a number is less than or greater than another, working with different types of numbers ❖</li> </ul>	<ul style="list-style-type: none"> <li>construct and solve one step equations with whole number solutions ❖</li> <li>list numbers between two points using the terminology 'less than or equal to' and 'greater than or equal to' ❖</li> </ul>

# Key Stage 2 Mathematics Programme of Study



Strands	Elements	Year 3	Year 4	Year 5	Year 6
		Learners are able to:	Learners are able to:	Learners are able to:	Learners are able to:
Using data skills	Collect and record data Present and analyse data Interpret results	<ul style="list-style-type: none"> <li>represent data using:                             <ul style="list-style-type: none"> <li>lists, tally charts, tables and diagrams</li> <li>bar charts and bar line graphs labelled in 2s, 5s and 10s</li> <li>pictograms where one symbol represents more than one unit using a key</li> <li>Venn and Carroll diagrams</li> </ul> </li> <li>extract and interpret information from charts, timetables, diagrams and graphs.</li> </ul>	<ul style="list-style-type: none"> <li>represent data using:                             <ul style="list-style-type: none"> <li>lists, tally charts, tables and diagrams</li> <li>bar charts and bar line graphs labelled in 2s, 5s and 10s</li> <li>pictograms where one symbol represents more than one unit using a key</li> <li>Venn and Carroll diagrams</li> </ul> </li> <li>extract and interpret information from charts, timetables, diagrams and graphs.</li> </ul>	<ul style="list-style-type: none"> <li>represent data using:                             <ul style="list-style-type: none"> <li>lists, tally charts, tables, diagrams and frequency tables</li> <li>bar charts, grouped data charts, line graphs and conversion graphs</li> </ul> </li> <li>extract and interpret information from an increasing range of diagrams, timetables and graphs (including pie charts)</li> <li>use mean, median, mode and range to describe a data set</li> </ul>	<ul style="list-style-type: none"> <li>represent data using:                             <ul style="list-style-type: none"> <li>lists, tally charts, tables, diagrams and frequency tables</li> <li>bar charts, grouped data charts, line graphs and conversion graphs</li> </ul> </li> <li>extract and interpret information from an increasing range of diagrams, timetables and graphs (including pie charts)</li> <li>use mean, median, mode and range to describe a data set</li> </ul>
	Probability			<ul style="list-style-type: none"> <li>use the words 'certain' and 'impossible' to describe the likelihood of an event occurring ❖</li> <li>recognise that some events are impossible and some events are certain ❖</li> <li>recognise that some events are more likely than others ❖</li> <li>use the words 'likely', 'unlikely' and 'even chance'. ❖</li> </ul>	<ul style="list-style-type: none"> <li>use numbers to describe the likelihood of an event, e.g. <i>a one-in-six chance</i> ❖</li> <li>recognise that some events are equally likely ❖</li> <li>identify the outcomes of simple events, e.g. <i>flipping a coin, rolling a dice.</i> ❖</li> </ul>



## National curriculum outcomes

The national curriculum outcomes describe the types and range of performance that learners working at a particular outcome should characteristically demonstrate. In deciding on a learner's outcome of attainment at the end of a key stage, teachers should judge which description best fits the learner's performance. Each description should be considered in conjunction with the descriptions for adjacent outcomes.

- Outcome 1** Learners anticipate, follow, respond to and join in with familiar number rhymes, stories, songs, activities and games. They show an awareness of number activities, recite, sign or indicate one or more numbers to 5 and count or indicate two objects. They are beginning to compare physical properties of objects. They demonstrate interest in position and the relationship between objects. They match objects or pictures by recognising similarities.
- 
- Outcome 2** Learners use mathematics in day-to-day activities and in their play, responding appropriately to key vocabulary and questions. They join in rote counting of numbers from 1 to 10. They recognise and name numbers 1 to 3, and count up to three objects reliably. They record numbers initially by making marks or drawing pictures. They begin to develop an understanding of one-to-one correspondence by matching pairs of different objects or pictures. They understand the concept of 'one more'. In daily activities, they develop an awareness of the purpose of money. They show understanding of words, signs and symbols that describe size and positions. They sort objects using one criterion, and are aware of contrasting qualities.
- 
- Outcome 3** Learners use familiar words in practical situations. They rote count to beyond 10, and onwards from a given small number. They carry out simple addition using numbers 1 to 5 and understand that zero means none. They recognise and try to record numerals from 1 to 9. They understand the concept of 'one less'. They compare and order two or more objects by direct observation. They show awareness of time in terms of their daily activities. They talk about or indicate, recognise and copy simple repeating patterns and sequences. When sorting, they recognise when an object is different and does not belong to a familiar category.



The following level descriptions describe the types and range of performance that learners working at a particular level should characteristically demonstrate. In deciding on a learner's level of attainment at the end of a key stage, teachers should judge which description best fits the learner's performance. Each description should be considered in conjunction with the descriptions for adjacent levels.

By the end of Key Stage 2, the performance of the great majority of learners is likely to be within the range of Levels 3 to 6, and by the end of Key Stage 3 within the range 4 to 7. Level 8 is available for very able learners and, to help teachers differentiate Exceptional Performance at Key Stage 3, a description above Level 8 is provided.

<b>Level 1</b>	Learners use mathematics as an integral part of classroom activities. They represent their work with objects or pictures and discuss it. They count, order, add and subtract numbers when solving problems involving up to 10 objects, and can read and write the numbers involved. They count on and back in steps of different sizes and from different numbers. They measure and order objects using direct comparison, and order events. They are aware of the value of different coins. They use everyday language to compare and to describe positions and properties of regular shapes. They recognise, use and make repeating patterns. They sort and classify objects, demonstrating the criterion they have used.
<b>Level 2</b>	Learners talk about their work using familiar mathematical language, and represent it using symbols and simple diagrams. They count sets of objects reliably, and use mental recall of number facts to 10 to add or subtract larger numbers. They order numbers up to 100. They choose the appropriate operation when solving addition or subtraction problems. They identify and use halves and quarters in practical situations. They recognise sequences of numbers. They use mental calculation strategies to solve number, money and measure problems. They use everyday non-standard and standard units to measure length and mass. They distinguish between straight and turning movements, recognise half-turns and quarter-turns and right angles in turns. They sort objects and classify them using more than one criterion. When they have gathered information, they record their results in simple lists, tables, diagrams and block graphs.
<b>Level 3</b>	Learners organise their work, check results, and try different approaches. They talk about and explain their work. They use and interpret mathematical symbols and diagrams. They find particular examples that satisfy a general statement. They use place value in numbers up to 1 000 to make approximations. They use decimal notation in recording money, and recognise negative numbers in the context of temperature. They develop further mental strategies for adding and subtracting numbers with at least two digits. They use mental recall of the 2, 3, 4, 5 and 10 multiplication tables in solving whole-number problems involving multiplication and division, including those giving rise to remainders. They use standard units of length, capacity, mass and time. They classify shapes in various ways. They extract and interpret information presented in simple tables and lists, and construct and interpret bar charts and pictograms.
<b>Level 4</b>	Learners develop their own strategies for solving problems, and present information and results systematically. They search for a solution by trying out ideas of their own. They use their understanding of place value to multiply and divide whole numbers by 10 and 100. They use a variety of mental and written methods for computation, including recall of multiplication facts up to 10 x 10. They add and subtract decimals to two places. They check their results are reasonable by considering the context or the size of the numbers. They use simple fractions and percentages to describe approximate parts of a whole. They recognise and describe number patterns and relationships and use simple formulae expressed in words. They use their knowledge of shape to make 3D mathematical models, draw common 2D shapes in different orientations on grids, and reflect simple shapes in a mirror line. They choose and use suitable units and instruments, reading, with appropriate accuracy, numbers on a range of measuring instruments. They find perimeters of shapes, areas by counting squares, and volumes by counting cubes. They use and interpret co-ordinates in the first quadrant. They collect discrete data, group data where appropriate, and use the mode and median as characteristics of a set of data. They draw and interpret frequency diagrams and construct and interpret simple line graphs. They understand and use simple vocabulary associated with probability.
<b>Level 5</b>	Learners identify and obtain information to solve problems, and check whether their results are sensible in the context of the problem. They describe situations mathematically using symbols, words and diagrams and draw their own conclusions, explaining their reasoning. They make general statements of their own, based on available evidence. They use their understanding of place value to multiply and divide whole numbers and decimals. They order, add and subtract negative numbers. They check their solutions by applying inverse operations or estimating using approximations. They calculate fractional or percentage parts of quantities and measurements. They construct and use simple formulae involving one or two operations. They use co-ordinates in all four quadrants. They measure and draw angles to the nearest degree. They recognise, identify and describe all the symmetries of 2D shapes. They convert one metric unit to another and know the rough metric equivalents of imperial units in daily use. They make sensible estimates of a range of everyday measures. They find areas of rectangles and triangles and volumes of cuboids. They read scales on maps, plans and graphs. They use the mean of discrete data and compare two simple distributions. They interpret graphs, diagrams and pie charts. They use the probability scale from 0 to 1, and appreciate that different outcomes may result from repeating an experiment.



<b>Level 6</b>	Learners solve complex problems by breaking them down into smaller tasks, and give some mathematical justifications to support their methods, arguments or conclusions. They interpret, discuss and synthesise information presented in a variety of mathematical forms. They use trial-and-improvement methods involving approximating and ordering decimals. They calculate one number as a fraction or percentage of another. They use the equivalences between fractions, decimals and percentages and calculate using ratios in appropriate situations. They find and describe in words the rule for the next term or nth term of a sequence where the rule is linear, and they formulate and solve a variety of simple linear equations. They represent mappings expressed algebraically. They use common 2D representations of 3D objects, and the properties of quadrilaterals to classify different types of quadrilateral. They solve problems using angle and symmetry properties of polygons and properties of intersecting and parallel lines. They use formulae for finding circumferences and areas of circles, areas of plane rectilinear figures and volumes of cuboids, and enlarge shapes by a positive whole-number scale factor. They collect and record continuous data, and construct and interpret frequency diagrams, pie charts and scatter diagrams. They use their knowledge that the total probability of all the mutually exclusive outcomes of an experiment is 1, and find and justify probabilities. They identify all the outcomes when dealing with a combination of two experiments.
<b>Level 7</b>	Learners justify their generalisations, arguments or solutions, consider alternative approaches and appreciate the difference between mathematical explanation and experimental evidence. They examine critically and justify their choice of mathematical presentation. In making estimates, they round to one significant figure and multiply and divide mentally. They understand the effects of multiplying and dividing by numbers between 0 and 1, and calculate proportional changes. They solve numerical problems with numbers of any size, using a calculator efficiently and appropriately. They describe in symbols the next term or nth term of a sequence with a quadratic rule. They use algebraic and graphical methods to solve simultaneous linear equations in two variables and solve simple inequalities. They use Pythagoras' theorem in two dimensions, calculate lengths, areas and volumes in plane shapes and right prisms, and enlarge shapes by a fractional scale factor. They appreciate the imprecision of measurement, and use compound measures such as speed. They specify and test hypotheses, taking account of bias. They analyse data to determine modal class and estimate the mean, median and range of sets of grouped data. They use measures of average and range to compare distributions, and draw a line of best fit on a scatter diagram by inspection. They use relative frequency as an estimate of probability and use this to compare outcomes of experiments.
<b>Level 8</b>	Learners develop and follow alternative approaches, reflecting on their own lines of enquiry and using a range of mathematical techniques. They examine and discuss generalisations or solutions they have reached. They convey mathematical or statistical meaning through precise and consistent use of symbols. They solve problems involving calculating with the extended number system, including powers, roots and standard form. They manipulate algebraic formulae, equations and expressions. They solve inequalities in two variables. They sketch and interpret graphs of linear, quadratic, cubic and reciprocal functions, and graphs that model real situations. They understand congruence and mathematical similarity, and use sine, cosine and tangent in right-angled triangles. They interpret and construct cumulative frequency tables and diagrams. They compare distributions and make inferences, using estimates of the median and inter-quartile range. They solve problems using the probability of a compound event.
<b>Exceptional Performance</b>	Learners give reasons for the choices they make when investigating within mathematics. They use mathematical language and symbols effectively in presenting a convincing reasoned argument, including mathematical justification. They express general laws in symbolic form. They solve problems using intersections and gradients of graphs. They use, generate and interpret graphs based on trigonometric functions. They solve problems in two and three dimensions using Pythagoras' theorem and trigonometric ratios. They calculate lengths of circular arcs, areas of sectors, surface areas of cylinders, and volumes of cones and spheres. They interpret and construct histograms. They understand how different sample sizes may affect the reliability of conclusions. They recognise when and how to use conditional probability.

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		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"> <li>transfer mathematical skills across the curriculum in a variety of contexts and everyday situations</li> <li>select, trial and evaluate a variety of possible approaches and break complex problems into a series of tasks</li> <li>prioritise and organise the relevant steps needed to complete the task or reach a solution</li> <li>choose an appropriate mental or written strategy and know when it is appropriate to use a calculator</li> <li>use a scientific calculator to carry out calculations effectively and efficiently using the available range of function keys</li> <li>identify, measure or obtain required information to complete the task <b>from a range of sources, including text</b> ▲</li> <li>identify what further information might be required and select what information is most appropriate</li> <li>select appropriate mathematics and techniques to use</li> <li>estimate and visualise size when measuring and use the correct units</li> <li><b>develop and evaluate mathematical strategies and ideas creatively</b> ❖</li> <li><b>consider connections between mathematical skills and contextualise these within extended tasks</b> ❖</li> </ul>		
	Represent and communicate	<ul style="list-style-type: none"> <li>explain results and procedures precisely using appropriate mathematical language</li> <li>refine methods of recording calculations</li> <li>use appropriate notation, symbols and units of measurement, including compound measures</li> <li>select and construct appropriate charts, diagrams and graphs with suitable scales</li> <li>interpret graphs that describe real-life situations, including those used in the media, recognising that some graphs may be misleading</li> <li><b>evaluate different forms of recording and presenting information, taking account of the context and audience</b> ❖</li> <li><b>generalise in words, and use algebra, to describe patterns that arise in numerical, spatial or practical situations</b> ❖</li> </ul>		
	Review	<ul style="list-style-type: none"> <li>select and apply appropriate checking strategies</li> <li>interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible</li> <li>verify and justify results or solutions, including discussion on risk and chance where relevant</li> <li>interpret mathematical information; draw inferences from graphs, diagrams and data, including discussion on limitations of data</li> <li>draw conclusions from data and recognise that some conclusions may be misleading or uncertain</li> <li><b>justify numerical and algebraic results, making appropriate connections</b> ❖</li> <li><b>explain and justify strategies, methods, reasoning and conclusions in a variety of different ways, including orally, graphically, in writing (both in mathematical notation and without), and using appropriate digital literacy equipment</b> ❖</li> <li><b>appreciate the difference between mathematical explanation and experimental evidence; recognise inconsistencies and bias</b> ❖</li> </ul>		

## 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 specific Mathematics Programme of Study skill will appear as bold. These skills are further identified by the following icons.

**Extended skill** ▲ **Programme of study skill** ❖ When combined with the LNF statements, these skills form the Key Stage 3 Mathematics Programme of Study.

## N.B.

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

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		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"> <li>read and write numbers of any size and use the four operations and the connections between them, e.g. <i>apply division as the inverse of multiplication</i></li> <li>recognise and apply key mental facts and strategies</li> <li>use appropriate strategies for multiplication and division, including application of known facts</li> <li><b>identify and use the lowest common multiple of two or more numbers</b> ❖</li> <li><b>identify and use the highest common factor of two or more numbers</b> ❖</li> <li><b>justify whether a number is a prime number or not</b> ❖</li> <li>use the terms square and square root</li> <li><b>express square numbers using powers</b> ❖</li> <li><b>identify triangular numbers</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>recognise and apply key mental facts and strategies</li> <li>use known facts to derive others, e.g. <i>use 7 x 6 to derive 0.7 x 6</i></li> <li>use the terms cube, cube root and reciprocal</li> <li><b>express cube numbers using powers</b> ❖</li> <li><b>express repeated multiplications as powers, e.g. <math>7 \times 7 \times 7 \times 7 \times 7 = 7^5</math></b> ❖</li> </ul>	<ul style="list-style-type: none"> <li><b>use known facts to derive others, e.g. use 7 x 6 to derive <math>42 \div 0.0006</math></b> ❖</li> <li>use powers and understand the importance of powers of 10, <b>and its application in standard form, e.g. <math>2^6 \times 2^8 = 2^{14}</math></b> ▲</li> <li>show awareness of the need for standard form and its representation on a calculator</li> <li><b>represent standard form on a calculator</b> ❖</li> <li><b>multiply, divide and use brackets with powers</b> ❖</li> <li><b>write a number as a product of its prime factors in index form</b> ❖</li> </ul>
	Fractions, decimals, percentages and ratio	<ul style="list-style-type: none"> <li>use equivalence of fractions, decimals, percentages <b>and ratio</b> to compare proportions ▲</li> <li>recognise that some fractions are recurring decimals, e.g. <math>\frac{1}{3}</math> is 0.333</li> <li>calculate percentages of quantities using non-calculator methods where appropriate</li> <li>use ratio and proportion including map scales</li> <li><b>express two or more quantities as a ratio using the correct notation</b> ❖</li> <li><b>simplify ratio</b> ❖</li> <li><b>add and subtract fractions</b> ❖</li> <li><b>convert between mixed numbers and improper fractions</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>use equivalence of fractions, decimals, percentages <b>and ratio</b> to select the most appropriate for a calculation ▲</li> <li>simplify a calculation by using fractions in their simplest terms</li> <li><b>express recurring decimals using correct notation</b> ❖</li> <li>calculate a percentage, fraction, decimal of any quantity with a calculator where appropriate</li> <li>calculate the outcome of a given percentage increase or decrease</li> <li><b>express one quantity as a percentage of another</b> ❖</li> <li><b>simplify ratios including those given in different units</b> ❖</li> <li>use ratio and proportion to calculate quantities, <b>including cases where the 'total' is not given</b> ▲</li> <li><b>add, subtract, multiply and divide fractions</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>use equivalence of fractions, decimals, percentages <b>and ratio</b> to select the most appropriate for a calculation ▲</li> <li>use, interpret <b>and calculate with</b> different representations of fractions, e.g. <i>mixed numbers and improper fractions</i> ▲</li> <li>calculate a percentage increase or decrease</li> <li>express one quantity as a percentage of another, <b>including those given in different units</b> ▲</li> <li>use ratio and proportion to calculate quantities, <b>including cases where the 'total' is not given</b> ▲</li> </ul>

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		Learners are able to:	Learners are able to:	Learners are able to:
Using number skills	Calculate using mental and written methods	<ul style="list-style-type: none"> <li>use efficient written methods to add and subtract numbers with up to 2 decimal places</li> <li>multiply and divide 3-digit by 2-digit whole numbers, extending to multiplying and dividing decimals with 1 or 2 places by single-digit whole numbers</li> <li>multiply and divide whole numbers by 0.5, 0.2, 0.1</li> <li>use the order of operations</li> <li><b>add and subtract with negative numbers using mental methods</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>use efficient written methods to add and subtract numbers with up to 2 decimal places</li> <li>use efficient methods for multiplication and division of whole numbers and decimals, including decimals such as 0.6 or 0.06</li> <li>use the order of operations including brackets</li> <li><b>multiply and divide with negative numbers using mental methods</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>use efficient written methods to add and subtract numbers and decimals of any size, including a mixture of large and small numbers with differing numbers of decimal places</li> <li>multiply and divide whole numbers and decimals</li> <li>use the order of operations including brackets and powers</li> <li><b>use the four operations in multistep calculations involving negative numbers, using mental and written methods</b> ❖</li> </ul>
	Estimate and check	<ul style="list-style-type: none"> <li>use a range of strategies to check calculations including the use of inverse operations, equivalent calculations and the rules of divisibility</li> <li>use rounding to estimate answers</li> <li>present answers to a given number of decimal places</li> </ul>	<ul style="list-style-type: none"> <li>use rounding to estimate answers to a given number of significant figures</li> <li>present answers to a given number of significant figures</li> </ul>	<ul style="list-style-type: none"> <li>make and justify estimates and approximations of calculations</li> <li>choose the appropriate degree of accuracy to present answers</li> </ul>
	Manage money	<ul style="list-style-type: none"> <li>use profit and loss in buying and selling calculations</li> <li>understand the advantages and disadvantages of using bank accounts, including bank cards</li> <li>make informed decisions relating to discounts and special offers</li> </ul>	<ul style="list-style-type: none"> <li>carry out calculations relating to VAT, saving and borrowing</li> <li>appreciate the basic principles of budgeting, saving (including understanding compound interest) and borrowing</li> <li><b>calculate using foreign money and exchange rates</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>calculate using foreign money and exchange rates</li> <li>understand the risks involved in different ways of saving and investing</li> <li>describe why insurance is important and understand the impact of not being insured</li> </ul>

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		Learners are able to:	Learners are able to:	Learners are able to:
Using measuring skills	Length, weight/mass, capacity	<ul style="list-style-type: none"> <li>find perimeters of shapes, <b>including compound shapes</b>, with straight sides ▲</li> <li><b>make estimates of length, weight/mass and capacity based on familiar and less familiar objects</b> ❖</li> <li>read and interpret scales on a range of measuring instruments</li> <li>convert between units of the metric system and carry out calculations</li> <li><b>understand that some measurements take particular values and others can take any value within a given range</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li><b>find circumferences of circles</b> ❖</li> <li>use the common units of measure, convert between related units of the metric system and carry out calculations</li> <li>use rough metric equivalents of imperial units in daily use</li> <li><b>recognise measurements that are discrete and those that are continuous</b> ❖</li> <li><b>interpret conversion graphs</b> ❖</li> </ul>	<ul style="list-style-type: none"> <li>find circumferences of circles <b>and perimeters of semicircles and quadrants</b> ▲</li> <li><b>derive and use Pythagoras' theorem</b> ❖</li> <li>make links between speed, distance and time</li> <li><b>understand and use a variety of compound measures, including speed and density</b> ❖</li> <li><b>define upper and lower bounds of discrete measurements</b> ❖</li> <li><b>recognise that there are different considerations for continuous data</b> ❖</li> </ul>
	Time	<ul style="list-style-type: none"> <li>measure and record time in hundredths of a second</li> <li><b>calculate start times, finish times and durations</b> ❖</li> <li><b>convert between times expressed as a decimal or fraction and hours, minutes and seconds, e.g. 1.5, 1.25, 1.75 hours</b> ❖</li> <li>use time zones <b>to compare times in different countries</b> ▲</li> </ul>	<ul style="list-style-type: none"> <li>interpret fractions of a second appropriately</li> <li><b>interpret time expressed as decimals and fractions and enter them appropriately on a calculator</b> ❖</li> <li>use timetables and time zones to calculate travel time <b>for a multi-stage journey</b> ▲</li> </ul>	<ul style="list-style-type: none"> <li><b>use timetables and time zones to plan a journey</b> ❖</li> </ul>
	Temperature	<ul style="list-style-type: none"> <li>record temperatures in appropriate temperature scales</li> </ul>	<ul style="list-style-type: none"> <li>convert temperatures between appropriate temperature scales</li> </ul>	<ul style="list-style-type: none"> <li>convert temperatures between appropriate temperature scales</li> </ul>

# Key Stage 3 Mathematics Programme of Study



		←	Year 7	↔	Year 8	↔	Year 9	→		
Strands	Elements	Learners are able to:			Learners are able to:					
Using measuring skills	Area and volume Angle and position	<ul style="list-style-type: none"> <li>• <b>devise and</b> use formulae for the area of rectangles and triangles ▲</li> <li>• <b>devise and use formulae to calculate the area of parallelograms</b> ❖</li> <li>• <b>calculate areas of compound shapes (e.g. consisting of rectangles and triangles) and volumes of simple solids (e.g. cubes and cuboids)</b> ❖</li> <li>• measure, draw <b>and label</b> angles <b>to the nearest degree, e.g. angle ABC</b> ▲</li> <li>• <b>use knowledge of angle types to estimate angles</b> ❖</li> <li>• <b>calculate angles on a straight line, around a point, vertically opposite and in triangles</b> ❖</li> </ul>			<ul style="list-style-type: none"> <li>• calculate areas of compound shapes (e.g. consisting of rectangles and triangles) and volumes of simple solids (e.g. cubes and cuboids)</li> <li>• <b>find areas of circles</b> ❖</li> <li>• <b>devise and use formulae to calculate the area of trapezia and kites</b> ❖</li> <li>• <b>calculate volumes of prisms constructed from cuboids, e.g. within an L-shaped cross-section</b> ❖</li> <li>• <b>explore angles on parallel lines</b> ❖</li> <li>• <b>understand exterior angles of triangles</b> ❖</li> <li>• <b>know and use the angle properties of quadrilaterals</b> ❖</li> <li>• <b>find horizontal and vertical distances using coordinates</b> ❖</li> <li>• <b>use bearings to describe the location of one object in relation to another</b> ❖</li> <li>• use compass bearings and grid references to specify location</li> </ul>			<ul style="list-style-type: none"> <li>• find areas of circles, <b>semicircles and quadrants</b> ▲</li> <li>• <b>calculate surface areas of cubes and cuboids</b> ❖</li> <li>• <b>calculate volumes of prisms and cylinders</b> ❖</li> <li>• <b>calculate angles on parallel lines</b> ❖</li> <li>• <b>calculate interior and exterior angles of polygons</b> ❖</li> <li>• <b>draw the relative position of objects given the bearing of one from the other</b> ❖</li> <li>• apply understanding of bearings and scale to interpret maps and plans, and to create plans and drawings to scale</li> </ul>		

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		Learners are able to:	Learners are able to:	Learners are able to:
Using geometry skills	Shape	<ul style="list-style-type: none"> <li>• make connections between nets and prisms and pyramids ❖</li> <li>• define solid shapes by their properties using the terms edges, faces, vertices and prism ❖</li> <li>• explain the properties of congruent shapes ❖</li> <li>• identify a radius and diameter and use the relationship between them ❖</li> <li>• identify a circumference ❖</li> </ul>	<ul style="list-style-type: none"> <li>• classify quadrilaterals ❖</li> <li>• explore the tessellation of two shapes ❖</li> <li>• recognise shapes that will or will not tessellate ❖</li> </ul>	<ul style="list-style-type: none"> <li>• recognise similar shapes and calculate the size of missing sides with whole number scale factor ❖</li> <li>• explore properties of shapes that tessellate ❖</li> </ul>
	Construction	<ul style="list-style-type: none"> <li>• construct circles using compasses ❖</li> <li>• recognise and draw to scale on square paper nets of cubes and cuboids ❖</li> <li>• draw triangles accurately given lengths and angles, using ruler and protractor ❖</li> </ul>	<ul style="list-style-type: none"> <li>• recognise and draw accurate nets of prisms ❖</li> <li>• represent 3D shapes on isometric paper and draw plans and elevations of 3D shapes made out of cubes ❖</li> <li>• construct triangles given three lengths, using a ruler and compasses ❖</li> <li>• identify sets of lengths that cannot form a triangle ❖</li> </ul>	<ul style="list-style-type: none"> <li>• select and use appropriate equipment to draw triangles when given sufficient angles and sides ❖</li> </ul>
	Movement	<ul style="list-style-type: none"> <li>• know the symmetrical properties of regular and irregular shapes ❖</li> <li>• rotate a shape on a grid ❖</li> <li>• translate a shape using a description, <i>e.g. 4 squares right and 2 squares down</i> ❖</li> <li>• describe a translation ❖</li> </ul>	<ul style="list-style-type: none"> <li>• explore symmetrical properties of 3D shapes; identify planes of symmetry ❖</li> <li>• enlarge shapes on square paper where the scale factor is a positive whole number ❖</li> </ul>	<ul style="list-style-type: none"> <li>• rotate shapes about the origin ❖</li> <li>• describe rotations about the origin ❖</li> <li>• enlarge a shape around a centre where the scale factor is positive ❖</li> <li>• explore locus where the path is a given distance from a point, line or shape ❖</li> </ul>

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		Learners are able to:	Learners are able to:	Learners are able to:
Using algebra skills	Number sequences	<ul style="list-style-type: none"> <li>distinguish between a term to term rule and an nth term rule ❖</li> <li>explore number sequences ❖</li> <li>express nth term rules involving one and two steps in words and symbols ❖</li> </ul>	<ul style="list-style-type: none"> <li>use algebra to express the nth term rule of a linear sequence ❖</li> <li>use the nth term rule to find particular terms ❖</li> <li>use the nth term rule to generate a sequence ❖</li> </ul>	<ul style="list-style-type: none"> <li>use the nth term rule to determine whether a number is in a sequence ❖</li> <li>determine the position number of a given term ❖</li> <li>distinguish between a linear and non-linear sequence ❖</li> </ul>
	Expressions and formulae	<ul style="list-style-type: none"> <li>show that <math>a + b = b + a</math> and <math>a - b</math> is not equal to <math>b - a</math> ❖</li> <li>show that <math>a \times b = b \times a</math> and <math>a/b</math> is not equal to <math>b/a</math> ❖</li> <li>know that <math>4g \times 2h = 8gh</math> ❖</li> <li>know that <math>b</math> divided by 2 is notated as <math>b/2</math> and <math>1/2b</math> ❖</li> <li>substitute positive whole numbers into one and two step expressions ❖</li> <li>simplify expressions involving the addition and subtraction of two or more variables ❖</li> </ul>	<ul style="list-style-type: none"> <li>know that <math>a \times a = a^2</math> ❖</li> <li>know that <math>2a \times a = 2a^2</math> ❖</li> <li>substitute positive and negative whole numbers into one and two step expressions ❖</li> <li>simplify expressions involving the addition and subtraction of two or more variables, including those where one or more of the simplified variables is negative ❖</li> <li>expand a single bracket ❖</li> <li>rearrange formulae involving two variables ❖</li> </ul>	<ul style="list-style-type: none"> <li>show and use rules that involve the multiplication, division and use of brackets with index variables ❖</li> <li>simplify expressions including expansion of a single bracket, including <math>a(b + c) + d(e + f)</math>, and double brackets ❖</li> <li>factorise algebraic expressions of two or more terms into a single bracket where there is one common factor ❖</li> <li>rearrange formulae involving two or more variables ❖</li> </ul>
	Functions and graphs	<ul style="list-style-type: none"> <li>express output generated from two (or more) step function machines, taking into account the order of operations using algebra ❖</li> <li>read, plot and write coordinates in all four quadrants ❖</li> </ul>	<ul style="list-style-type: none"> <li>express output generated from function machines, taking into account the order of operations ❖</li> <li>generate and plot points for linear functions ❖</li> </ul>	<ul style="list-style-type: none"> <li>examine features of linear functions, read an intercept from a graph, and recognise positive and negative gradients ❖</li> <li>recognise the impact of the coefficient of <math>x</math> on the gradient of the line ❖</li> </ul>

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		Learners are able to:	Learners are able to:	Learners are able to:
Using algebra skills	Equations and inequalities	<ul style="list-style-type: none"> <li>• solve two step equations ❖</li> <li>• express a set of numbers as a single inequality using <math>&lt; &gt; \leq \geq</math> ❖</li> <li>• give solutions for inequalities <math>&lt; &gt; \leq \geq</math>, recognising that there are an infinite number of solutions ❖</li> </ul>	<ul style="list-style-type: none"> <li>• solve equations including those where the solution is a negative, a fraction or a decimal and those that include brackets ( ) ❖</li> <li>• give a set of solutions from an inequality with two boundaries and show them on a number line ❖</li> <li>• express a set of numbers as an inequality ❖</li> <li>• complete and interpret simple information and distance–time graphs, showing an understanding of gradients within the context of the question ❖</li> </ul>	<ul style="list-style-type: none"> <li>• construct and solve equations that include brackets ( ) and <math>a( ) + b( )</math> ❖</li> <li>• construct and solve equations where the variable appears on both sides of the equals sign ❖</li> <li>• solve equations by trial and improvement and justify the solution ❖</li> <li>• express situations as inequalities ❖</li> <li>• solve inequalities and show the solutions on a number line ❖</li> <li>• construct and interpret information graphs that relate to a variety of situations, e.g. <i>running a bath</i> ❖</li> </ul>
Using data skills	Collect and record data Present and analyse data Interpret results	<ul style="list-style-type: none"> <li>• collect own data for a survey, e.g. <i>through designing a questionnaire</i></li> <li>• construct frequency tables for sets of data, grouped where appropriate, in equal class intervals (groups given to learners)</li> <li>• construct a wide range of graphs and diagrams to represent the data and reflect the importance of scale</li> <li>• interpret diagrams and graphs (including pie charts)</li> <li>• use mean, median, mode and range to compare two distributions (discrete data)</li> </ul>	<ul style="list-style-type: none"> <li>• plan how to collect data to test hypotheses</li> <li>• construct a wide range of graphs and diagrams to represent discrete and continuous data</li> <li>• construct frequency tables for sets of data in equal class intervals, selecting groups as appropriate</li> <li>• construct graphs to represent data including scatter diagrams to investigate correlation</li> <li>• interpret diagrams and graphs to compare sets of data</li> <li>• <b>find the mean, median, mode and range from ungrouped frequency tables</b> ❖</li> <li>• use mean, median, mode and range to compare two distributions (continuous data)</li> </ul>	<ul style="list-style-type: none"> <li>• test hypotheses, making decisions about how best to record and analyse the information from large data sets</li> <li>• construct and interpret graphs and diagrams (including pie charts) to represent discrete or continuous data, with the learner choosing an appropriate scale</li> <li>• select and justify statistics most appropriate to the problem considering extreme values (outliers)</li> <li>• examine results critically, select and justify choice of statistics recognising the limitations of any assumptions and their effect on the conclusions drawn</li> <li>• use appropriate mathematical instruments and methods to construct accurate drawings</li> <li>• <b>find the mean, median, mode and range from grouped frequency tables and explain why it is an estimate</b> ❖</li> </ul>

# Key Stage 3 Mathematics Programme of Study



Strands	Elements	Year 7	Year 8	Year 9
		Learners are able to:	Learners are able to:	Learners are able to:
Using data skills	Probability	<ul style="list-style-type: none"> <li>recognise that impossible = 0 and certain = 1 and that the probability of an event will lie on a scale between 0 and 1 ❖</li> <li>express the probability of an event as a fraction or decimal percentage ❖</li> <li>give examples of events that have a probability of <math>\frac{1}{2}</math> ❖</li> <li>determine events with two outcomes that are/aren't equally likely ❖</li> <li>record all the outcomes of two events as an exhaustive list ❖</li> <li>estimate the number of successes of an event, e.g. flipping a coin ten times, how many heads would be expected? ❖</li> </ul>	<ul style="list-style-type: none"> <li>show that the sum of all probabilities = 1 ❖</li> <li>recognise that some outcomes cannot occur simultaneously, e.g. a coin cannot show heads and tails at the same time ❖</li> <li>know that events that have two outcomes are not necessarily equally likely ❖</li> <li>complete a sample space diagram and a two way table ❖</li> <li>estimate the number of successes of an event, e.g. rolling a fair dice 300 times, how many 3s would be expected? ❖</li> </ul>	<ul style="list-style-type: none"> <li>use the sum of all probabilities is 1 – simple cases, e.g. rolling a dice <math>P(\text{not } 6)</math> ❖</li> <li>recognise that practice is different from theory and that repeated experiments may give different results ❖</li> <li>understand that reliability/stability increases with a greater number of trials ❖</li> <li>construct a sample space diagram and a two way table. ❖</li> </ul>



The national curriculum outcomes describe the types and range of performance that learners working at a particular outcome should characteristically demonstrate. In deciding on a learner's outcome of attainment at the end of a key stage, teachers should judge which description best fits the learner's performance. Each description should be considered in conjunction with the descriptions for adjacent outcomes.

- Outcome 1** Learners anticipate, follow, respond to and join in with familiar number rhymes, stories, songs, activities and games. They show an awareness of number activities, recite, sign or indicate one or more numbers to 5 and count or indicate two objects. They are beginning to compare physical properties of objects. They demonstrate interest in position and the relationship between objects. They match objects or pictures by recognising similarities.
- 
- Outcome 2** Learners use mathematics in day-to-day activities and in their play, responding appropriately to key vocabulary and questions. They join in rote counting of numbers from 1 to 10. They recognise and name numbers 1 to 3, and count up to three objects reliably. They record numbers initially by making marks or drawing pictures. They begin to develop an understanding of one-to-one correspondence by matching pairs of different objects or pictures. They understand the concept of 'one more'. In daily activities, they develop an awareness of the purpose of money. They show understanding of words, signs and symbols that describe size and positions. They sort objects using one criterion, and are aware of contrasting qualities.
- 
- Outcome 3** Learners use familiar words in practical situations. They rote count to beyond 10, and onwards from a given small number. They carry out simple addition using numbers 1 to 5 and understand that zero means none. They recognise and try to record numerals from 1 to 9. They understand the concept of 'one less'. They compare and order two or more objects by direct observation. They show awareness of time in terms of their daily activities. They talk about or indicate, recognise and copy simple repeating patterns and sequences. When sorting, they recognise when an object is different and does not belong to a familiar category.



The following level descriptions describe the types and range of performance that learners working at a particular level should characteristically demonstrate. In deciding on a learner's level of attainment at the end of a key stage, teachers should judge which description best fits the learner's performance. Each description should be considered in conjunction with the descriptions for adjacent levels.

By the end of Key Stage 2, the performance of the great majority of learners is likely to be within the range of Levels 3 to 6, and by the end of Key Stage 3 within the range 4 to 7. Level 8 is available for very able learners and, to help teachers differentiate Exceptional Performance at Key Stage 3, a description above Level 8 is provided.

<b>Level 1</b>	Learners use mathematics as an integral part of classroom activities. They represent their work with objects or pictures and discuss it. They count, order, add and subtract numbers when solving problems involving up to 10 objects, and can read and write the numbers involved. They count on and back in steps of different sizes and from different numbers. They measure and order objects using direct comparison, and order events. They are aware of the value of different coins. They use everyday language to compare and to describe positions and properties of regular shapes. They recognise, use and make repeating patterns. They sort and classify objects, demonstrating the criterion they have used.
<b>Level 2</b>	Learners talk about their work using familiar mathematical language, and represent it using symbols and simple diagrams. They count sets of objects reliably, and use mental recall of number facts to 10 to add or subtract larger numbers. They order numbers up to 100. They choose the appropriate operation when solving addition or subtraction problems. They identify and use halves and quarters in practical situations. They recognise sequences of numbers. They use mental calculation strategies to solve number, money and measure problems. They use everyday non-standard and standard units to measure length and mass. They distinguish between straight and turning movements, recognise half-turns and quarter-turns and right angles in turns. They sort objects and classify them using more than one criterion. When they have gathered information, they record their results in simple lists, tables, diagrams and block graphs.
<b>Level 3</b>	Learners organise their work, check results, and try different approaches. They talk about and explain their work. They use and interpret mathematical symbols and diagrams. They find particular examples that satisfy a general statement. They use place value in numbers up to 1 000 to make approximations. They use decimal notation in recording money, and recognise negative numbers in the context of temperature. They develop further mental strategies for adding and subtracting numbers with at least two digits. They use mental recall of the 2, 3, 4, 5 and 10 multiplication tables in solving whole-number problems involving multiplication and division, including those giving rise to remainders. They use standard units of length, capacity, mass and time. They classify shapes in various ways. They extract and interpret information presented in simple tables and lists, and construct and interpret bar charts and pictograms.
<b>Level 4</b>	Learners develop their own strategies for solving problems, and present information and results systematically. They search for a solution by trying out ideas of their own. They use their understanding of place value to multiply and divide whole numbers by 10 and 100. They use a variety of mental and written methods for computation, including recall of multiplication facts up to 10 x 10. They add and subtract decimals to two places. They check their results are reasonable by considering the context or the size of the numbers. They use simple fractions and percentages to describe approximate parts of a whole. They recognise and describe number patterns and relationships and use simple formulae expressed in words. They use their knowledge of shape to make 3D mathematical models, draw common 2D shapes in different orientations on grids, and reflect simple shapes in a mirror line. They choose and use suitable units and instruments, reading, with appropriate accuracy, numbers on a range of measuring instruments. They find perimeters of shapes, areas by counting squares, and volumes by counting cubes. They use and interpret co-ordinates in the first quadrant. They collect discrete data, group data where appropriate, and use the mode and median as characteristics of a set of data. They draw and interpret frequency diagrams and construct and interpret simple line graphs. They understand and use simple vocabulary associated with probability.
<b>Level 5</b>	Learners identify and obtain information to solve problems, and check whether their results are sensible in the context of the problem. They describe situations mathematically using symbols, words and diagrams and draw their own conclusions, explaining their reasoning. They make general statements of their own, based on available evidence. They use their understanding of place value to multiply and divide whole numbers and decimals. They order, add and subtract negative numbers. They check their solutions by applying inverse operations or estimating using approximations. They calculate fractional or percentage parts of quantities and measurements. They construct and use simple formulae involving one or two operations. They use co-ordinates in all four quadrants. They measure and draw angles to the nearest degree. They recognise, identify and describe all the symmetries of 2D shapes. They convert one metric unit to another and know the rough metric equivalents of imperial units in daily use. They make sensible estimates of a range of everyday measures. They find areas of rectangles and triangles and volumes of cuboids. They read scales on maps, plans and graphs. They use the mean of discrete data and compare two simple distributions. They interpret graphs, diagrams and pie charts. They use the probability scale from 0 to 1, and appreciate that different outcomes may result from repeating an experiment.



<b>Level 6</b>	Learners solve complex problems by breaking them down into smaller tasks, and give some mathematical justifications to support their methods, arguments or conclusions. They interpret, discuss and synthesise information presented in a variety of mathematical forms. They use trial-and-improvement methods involving approximating and ordering decimals. They calculate one number as a fraction or percentage of another. They use the equivalences between fractions, decimals and percentages and calculate using ratios in appropriate situations. They find and describe in words the rule for the next term or nth term of a sequence where the rule is linear, and they formulate and solve a variety of simple linear equations. They represent mappings expressed algebraically. They use common 2D representations of 3D objects, and the properties of quadrilaterals to classify different types of quadrilateral. They solve problems using angle and symmetry properties of polygons and properties of intersecting and parallel lines. They use formulae for finding circumferences and areas of circles, areas of plane rectilinear figures and volumes of cuboids, and enlarge shapes by a positive whole-number scale factor. They collect and record continuous data, and construct and interpret frequency diagrams, pie charts and scatter diagrams. They use their knowledge that the total probability of all the mutually exclusive outcomes of an experiment is 1, and find and justify probabilities. They identify all the outcomes when dealing with a combination of two experiments.
<b>Level 7</b>	Learners justify their generalisations, arguments or solutions, consider alternative approaches and appreciate the difference between mathematical explanation and experimental evidence. They examine critically and justify their choice of mathematical presentation. In making estimates, they round to one significant figure and multiply and divide mentally. They understand the effects of multiplying and dividing by numbers between 0 and 1, and calculate proportional changes. They solve numerical problems with numbers of any size, using a calculator efficiently and appropriately. They describe in symbols the next term or nth term of a sequence with a quadratic rule. They use algebraic and graphical methods to solve simultaneous linear equations in two variables and solve simple inequalities. They use Pythagoras' theorem in two dimensions, calculate lengths, areas and volumes in plane shapes and right prisms, and enlarge shapes by a fractional scale factor. They appreciate the imprecision of measurement, and use compound measures such as speed. They specify and test hypotheses, taking account of bias. They analyse data to determine modal class and estimate the mean, median and range of sets of grouped data. They use measures of average and range to compare distributions, and draw a line of best fit on a scatter diagram by inspection. They use relative frequency as an estimate of probability and use this to compare outcomes of experiments.
<b>Level 8</b>	Learners develop and follow alternative approaches, reflecting on their own lines of enquiry and using a range of mathematical techniques. They examine and discuss generalisations or solutions they have reached. They convey mathematical or statistical meaning through precise and consistent use of symbols. They solve problems involving calculating with the extended number system, including powers, roots and standard form. They manipulate algebraic formulae, equations and expressions. They solve inequalities in two variables. They sketch and interpret graphs of linear, quadratic, cubic and reciprocal functions, and graphs that model real situations. They understand congruence and mathematical similarity, and use sine, cosine and tangent in right-angled triangles. They interpret and construct cumulative frequency tables and diagrams. They compare distributions and make inferences, using estimates of the median and inter-quartile range. They solve problems using the probability of a compound event.
<b>Exceptional Performance</b>	Learners give reasons for the choices they make when investigating within mathematics. They use mathematical language and symbols effectively in presenting a convincing reasoned argument, including mathematical justification. They express general laws in symbolic form. They solve problems using intersections and gradients of graphs. They use, generate and interpret graphs based on trigonometric functions. They solve problems in two and three dimensions using Pythagoras' theorem and trigonometric ratios. They calculate lengths of circular arcs, areas of sectors, surface areas of cylinders, and volumes of cones and spheres. They interpret and construct histograms. They understand how different sample sizes may affect the reliability of conclusions. They recognise when and how to use conditional probability.

# 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"> <li>transfer mathematical skills across the curriculum in a variety of contexts and everyday situations</li> <li>select, trial and evaluate a variety of possible approaches and break complex problems into a series of tasks</li> <li>prioritise and organise the relevant steps needed to complete the task or reach a solution</li> <li>choose an appropriate mental or written strategy and know when it is appropriate to use a calculator</li> <li>use a scientific calculator to carry out calculations effectively and efficiently using the available range of function keys</li> <li>identify, measure or obtain required information to complete the task</li> <li>identify what further information might be required and select what information is most appropriate</li> <li>select appropriate mathematics and techniques to use</li> <li>estimate and visualise size when measuring and use the correct units</li> <li><b>develop and evaluate mathematical strategies and ideas creatively</b> ❖</li> <li><b>consider connections between mathematical skills and contextualise these</b> ❖</li> </ul>		
	Represent and communicate	<ul style="list-style-type: none"> <li>explain results and procedures precisely using appropriate mathematical language</li> <li>refine methods of recording calculations</li> <li>use appropriate notation, symbols and units of measurement, including compound measures</li> <li>select and construct appropriate charts, diagrams and graphs with suitable scales</li> <li>interpret graphs that describe real-life situations, including those used in the media, recognising that some graphs may be misleading</li> <li><b>evaluate different forms of recording and presenting information, taking account of the context and audience</b> ❖</li> <li><b>generalise in words, and use algebra, to describe patterns that arise in numerical, spatial or practical situations</b> ❖</li> </ul>		
	Review	<ul style="list-style-type: none"> <li>select and apply appropriate checking strategies</li> <li>interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible</li> <li>verify and justify results or solutions, including discussion on risk and chance where relevant</li> <li>interpret mathematical information; draw inferences from graphs, diagrams and data, including discussion on limitations of data</li> <li>draw conclusions from data and recognise that some conclusions may be misleading or uncertain</li> <li><b>recognise that inferences drawn from data may suggest the need for further investigation</b> ❖</li> <li><b>justify numerical and algebraic results, making appropriate connections</b> ❖</li> <li><b>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</b> ❖</li> <li><b>appreciate the difference between mathematical explanation and experimental evidence; recognise inconsistencies and bias</b> ❖</li> </ul>		

## 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 specific Mathematics Programme of Study skill will appear as bold. These skills are further identified by the following icons.

**Extended skill** ▲ **Programme of study skill** ❖ When combined with the LNF statements, these skills form the Key Stage 4 Mathematics Programme of Study.

## N.B.

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

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

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

# 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:
Using measuring skills	Time	<ul style="list-style-type: none"> <li>• use timetables and time zones to plan a multi-stage journey ❖</li> <li>• plan the optimum route from a selection of timetables ❖</li> </ul>		
	Temperature			
	Area and volume Angle and position	<ul style="list-style-type: none"> <li>• apply proportional change to 2-dimensional designs</li> <li>• find areas of semicircles and quadrants, including cases that require a solution expressed in terms of pi ❖</li> <li>• find a radius or diameter given an area ❖</li> <li>• convert between metric units of area ❖</li> <li>• convert between metric units of volume ❖</li> <li>• calculate an angle in a right angled triangle using trigonometry ❖</li> <li>• find the distance between two points from their coordinates ❖</li> <li>• find the midpoint of a line ❖</li> <li>• find locations given sets of bearings and/or distances ❖</li> </ul>	<ul style="list-style-type: none"> <li>• find surface areas of prisms, cylinders and spheres ❖</li> <li>• calculate sector area ❖</li> <li>• distinguish between formulae for length, area and volume, and check that a formula is dimensionally correct ❖</li> <li>• calculate volumes of spheres, hemispheres, cones and pyramids ❖</li> <li>• use circle theorems to calculate angles in circles ❖</li> <li>• use trigonometry in situations including those involving bearings, and angles of elevation and depression ❖</li> <li>• use coordinates in 3 dimensions ❖</li> </ul>	<ul style="list-style-type: none"> <li>• calculate segment area ❖</li> <li>• calculate the surface area of cones ❖</li> <li>• calculate volumes of compound solids ❖</li> <li>• use the alternate segment theorem ❖</li> <li>• understand and construct geometrical proofs using circle theorems ❖</li> <li>• sketch and use trigonometric graphs ❖</li> <li>• use trigonometry in non-right angled triangles ❖</li> <li>• use the sine and cosine rule ❖</li> <li>• use trigonometry to find an angle in 3 dimensions ❖</li> </ul>

# 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:
Using geometry skills	Shape	<ul style="list-style-type: none"> <li>recognise similar shapes and calculate the size of missing sides ❖</li> <li>use the terms arc, sector, segment, chord, tangent ❖</li> </ul>	<ul style="list-style-type: none"> <li>find the area of a 2D shape given the area of a similar shape and a pair of corresponding sides ❖</li> <li>find the volume of a similar shape given the volume of a similar shape and a pair of corresponding edges ❖</li> </ul>	<ul style="list-style-type: none"> <li>prove that two triangles are congruent ❖</li> <li>use the conditions for congruent triangles in formal proofs ❖</li> </ul>
	Construction	<ul style="list-style-type: none"> <li>draw plans and elevations of any 3D solid ❖</li> <li>construct perpendicular bisectors, the perpendicular from a point to a line, angles of 60° and 90°, and the bisector of an angle ❖</li> <li>shade a region defined by up to two conditions ❖</li> </ul>	<ul style="list-style-type: none"> <li>draw accurate plans and elevations of any 3D solid to an appropriate scale ❖</li> <li>select and apply loci to solve problems given more than two conditions ❖</li> </ul>	
	Movement	<ul style="list-style-type: none"> <li>reflect shapes in horizontal and vertical lines ❖</li> <li>describe reflection in horizontal or vertical lines ❖</li> <li>rotate shapes about a point ❖</li> <li>describe rotations and find the centre of rotation ❖</li> <li>translate a shape by a vector ❖</li> <li>describe a translation using vectors ❖</li> <li>enlarge a shape from a centre where the scale factor is 0.5 ❖</li> </ul>	<ul style="list-style-type: none"> <li>reflect shapes in the lines <math>y = x</math> and <math>y = -x</math> ❖</li> <li>enlarge a shape from a centre where the scale factor is a fraction ❖</li> <li>find the centre of enlargement ❖</li> <li>recognise and describe transformations ❖</li> </ul>	<ul style="list-style-type: none"> <li>enlarge a shape from a centre with a negative scale factor ❖</li> <li>recognise and describe combinations of transformations ❖</li> </ul>

# 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:
Using algebra skills	Number sequences	<ul style="list-style-type: none"> <li>generate non-linear sequences given the nth term rule ❖</li> </ul>	<ul style="list-style-type: none"> <li>express the nth term rules algebraically, e.g. <math>n^2</math>, <math>n^2 + 1</math>, <math>n^2 + 3</math>, <math>n^2 - 3</math>, <math>n^3</math> ❖</li> </ul>	<ul style="list-style-type: none"> <li>generate complex non-linear sequences given the nth term rule ❖</li> <li>express nth term rules algebraically, e.g. <math>2n^2 + 6</math>, <math>(n + a)^2</math>, <math>an^2 + bn + c</math> where <math>a</math> is not equal to 0 ❖</li> </ul>
	Expressions and formulae	<ul style="list-style-type: none"> <li>manipulate indices, e.g. <math>(2a^2)^3</math> ❖</li> <li>show and use rules of indices where the power is 0 or a fraction with numerator 1 ❖</li> <li>substitute into a variety of expressions, including those involving powers and brackets ❖</li> <li>multiply out double brackets ❖</li> <li>factorise algebraic expressions of two or more terms into a single bracket, including those where there is more than one common factor ❖</li> <li>rearrange formulae including whole number powers and brackets ❖</li> <li>distinguish between equations, formulae and expressions ❖</li> </ul>	<ul style="list-style-type: none"> <li>show and use indices rules where the power is a negative whole number or a proper fraction ❖</li> <li>recognise situations that require substitution, e.g. <i>drawing graphs</i> ❖</li> <li>factorise quadratic expressions where the coefficient of <math>x^2</math> is 1, including the difference of two squares ❖</li> <li>rearrange formulae involving brackets and powers ❖</li> </ul>	<ul style="list-style-type: none"> <li>rearrange formulae, including cases that require factorisation ❖</li> <li>simplify algebraic fractions ❖</li> <li>show and use indices rules where the power is a negative fraction or the base is a positive fraction ❖</li> <li>factorise quadratic expressions ❖</li> <li>distinguish between equations, formulae, expressions and identities ❖</li> </ul>
	Functions and graphs	<ul style="list-style-type: none"> <li>generate and plot points for simple quadratic and cubic functions ❖</li> <li>solve simple linear simultaneous equations graphically ❖</li> <li>construct graphs and define regions to show one inequality <math>&lt;&gt; \leq \geq</math> ❖</li> </ul>	<ul style="list-style-type: none"> <li>state the equation of parallel lines given facts or a graph ❖</li> <li>generate and plot points for quadratic and cubic functions ❖</li> <li>generate and plot points for simple reciprocal graphs ❖</li> <li>generate, plot points and use exponential graphs of the function <math>y = k^x</math> ❖</li> <li>solve linear simultaneous equations graphically ❖</li> <li>identify key features of, and distinguish between, graphs of linear, quadratic, cubic and reciprocal functions ❖</li> <li>construct graphs and define regions to show 2 or more inequalities ❖</li> </ul>	<ul style="list-style-type: none"> <li>find the equation of a line from a graph ❖</li> <li>state the equation of a perpendicular line given facts or a graph ❖</li> <li>construct or define regions given by 3 or more inequalities ❖</li> <li>transform graphs of functions ❖</li> </ul>

# 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:
Using algebra skills	Equations and inequalities	<ul style="list-style-type: none"> <li>• solve equations by trial and improvement, and justify the solution ❖</li> <li>• solve linear simultaneous equations with matching coefficients ❖</li> <li>• draw inferences from distance–time graphs ❖</li> </ul>	<ul style="list-style-type: none"> <li>• solve linear simultaneous equations ❖</li> <li>• solve a quadratic equation where the coefficient of <math>x^2</math> is 1 by factorising ❖</li> <li>• examine rates of change, <i>e.g. vases and water</i> ❖</li> </ul>	<ul style="list-style-type: none"> <li>• construct and solve equations involving direct and inverse proportion, algebraically or otherwise ❖</li> <li>• solve quadratic equations by selection of an appropriate method ❖</li> <li>• find the distance travelled from speed–time graphs ❖</li> <li>• construct tangents to curves and interpret their gradients ❖</li> <li>• interpret the meaning of the area under a graph ❖</li> </ul>
Using data skills	Collect and record data Present and analyse data Interpret results	<ul style="list-style-type: none"> <li>• specify and test hypotheses, taking account of sampling ❖</li> <li>• identify possible sources of bias in the design of collection sheets and questionnaires ❖</li> <li>• evaluate questionnaires and write suitable questions, including response boxes ❖</li> <li>• 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 ❖</li> <li>• calculate the upper quartile, lower quartile and interquartile range of a set of discrete data and use them to describe a data set ❖</li> <li>• use a scatter diagram to make predictions about the data from a line of best fit drawn by eye ❖</li> <li>• understand the effects of extrapolation and interpolation on reliability ❖</li> <li>• use the mean, median, mode and range from grouped frequency tables to compare distributions ❖</li> </ul>	<ul style="list-style-type: none"> <li>• specify and test hypotheses, taking account of the limitations of the data ❖</li> <li>• consider the effect of sample size and other factors that affect the reliability of conclusions drawn ❖</li> <li>• sample systematically ❖</li> <li>• 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 and boxplots ❖</li> <li>• use a scatter diagram to make predictions about the data from a line of best fit that passes through the mean ❖</li> <li>• use a cumulative frequency curve to estimate the median, quartiles and interquartile range ❖</li> <li>• use the interquartile range to compare distributions ❖</li> <li>• compare sets of data and their distributions, using appropriate methods, including those that involve describing central tendency, dispersion, correlation ❖</li> <li>• recognise and use the most appropriate data to compare distributions ❖</li> </ul>	<ul style="list-style-type: none"> <li>• work with stratified sampling techniques ❖</li> <li>• define a random sample ❖</li> <li>• 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 ❖</li> <li>• compare sets of data and their distributions, using appropriate methods, including those that involve describing central tendency, dispersion, correlation ❖</li> <li>• recognise and use the most appropriate data to compare distributions ❖</li> </ul>

# Key Stage 4 Mathematics Programme of Study



		←	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"> <li>• 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 ❖</li> <li>• compare an estimated probability from experimental results with a theoretical probability ❖</li> <li>• identify when to construct sample space diagrams or two way tables to solve a problem ❖</li> <li>• use a two way table and sample space diagram to calculate the probability of simple compound events ❖</li> <li>• use a two way table to calculate simple cases of <math>x</math> given <math>y</math>, e.g. <i>find the probability that a girl travels by bus</i> ❖</li> <li>• estimate the number of successes where probability is expressed as a fraction or decimal. ❖</li> </ul>		<ul style="list-style-type: none"> <li>• understand dependent and independent outcomes ❖</li> <li>• use relative frequency to test a given probability ❖</li> <li>• complete a tree diagram for two or more independent events ❖</li> <li>• use tree diagrams to calculate the probability of combined events. ❖</li> </ul>		<ul style="list-style-type: none"> <li>• construct and use a tree diagram for two or more dependent events. ❖</li> </ul>	