Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Developing numerical reasoning	**Identify processes and connections**	• transfer mathematical skills across the curriculum in a variety of contexts and everyday situations • select, trial and evaluate a variety of possible approaches and break complex problems into a series of tasks • prioritise and organise the relevant steps needed to complete the task or reach a solution • choose an appropriate mental or written strategy and know when it is appropriate to use a calculator • use a scientific calculator to carry out calculations effectively and efficiently using the available range of function keys • identify, measure or obtain required information to complete the task **from a range of sources, including text ▲** • identify what further information might be required and select what information is most appropriate • select appropriate mathematics and techniques to use • estimate and visualise size when measuring and use the correct units • **develop and evaluate mathematical strategies and ideas creatively ❖** • **consider connections between mathematical skills and contextualise these within extended tasks ❖**		
	Represent and communicate	• explain results and procedures precisely using appropriate mathematical language • refine methods of recording calculations • use appropriate notation, symbols and units of measurement, including compound measures • select and construct appropriate charts, diagrams and graphs with suitable scales • interpret graphs that describe real-life situations, including those used in the media, recognising that some graphs may be misleading • **evaluate different forms of recording and presenting information, taking account of the context and audience ❖** • **generalise in words, and use algebra, to describe patterns that arise in numerical, spatial or practical situations ❖**		
	Review	• select and apply appropriate checking strategies • interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible • verify and justify results or solutions, including discussion on risk and chance where relevant • interpret mathematical information; draw inferences from graphs, diagrams and data, including discussion on limitations of data • draw conclusions from data and recognise that some conclusions may be misleading or uncertain • **justify numerical and algebraic results, making appropriate connections ❖** • **explain and justify strategies, methods, reasoning and conclusions in a variety of different ways, including orally, graphically, in writing (both in mathematical notation and without), and using appropriate digital literacy equipment ❖** • **appreciate the difference between mathematical explanation and experimental evidence; recognise inconsistencies and bias ❖**		

Key

Within the table, text taken from the LNF will appear as non-bold. Text that has been extended from the LNF or that is a 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.

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Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using number skills	**Use number facts and relationships**	• read and write numbers of any size and use the four operations and the connections between them, *e.g. apply division as the inverse of multiplication* • recognise and apply key mental facts and strategies • use appropriate strategies for multiplication and division, including application of known facts • **identify and use the lowest common multiple of two or more numbers** ❖ • **identify and use the highest common factor of two or more numbers** ❖ • **justify whether a number is a prime number or not** ❖ • use the terms square and square root • **express square numbers using powers** ❖ • **identify triangular numbers** ❖	• recognise and apply key mental facts and strategies • use known facts to derive others, *e.g. use 7 x 6 to derive 0.7 x 6* • use the terms cube, cube root and reciprocal • **express cube numbers using powers** ❖ • **express repeated multiplications as powers, *e.g. 7 x 7 x 7 x 7 x 7 x 7 = 7^6*** ❖	• **use known facts to derive others, *e.g. use 7 x 6 to derive 42 ÷ 0.0006*** ❖ • use powers and understand the importance of powers of 10, **and its application in standard form, *e.g. $2^6 \times 2^8 = 2^{14}$*** ▲ • show awareness of the need for standard form and its representation on a calculator • **represent standard form on a calculator** ❖ • **multiply, divide and use brackets with powers** ❖ • **write a number as a product of its prime factors in index form** ❖
	Fractions, decimals, percentages and ratio	• use equivalence of fractions, decimals, percentages **and ratio** to compare proportions ▲ • recognise that some fractions are recurring decimals, *e.g. $\frac{1}{3}$ is $0.33\dot{3}$* • calculate percentages of quantities using non-calculator methods where appropriate • use ratio and proportion including map scales • **express two or more quantities as a ratio using the correct notation** ❖ • **simplify ratio** ❖ • **add and subtract fractions** ❖ • **convert between mixed numbers and improper fractions** ❖	• use equivalence of fractions, decimals, percentages **and ratio** to select the most appropriate for a calculation ▲ • simplify a calculation by using fractions in their simplest terms • **express recurring decimals using correct notation** ❖ • calculate a percentage, fraction, decimal of any quantity with a calculator where appropriate • calculate the outcome of a given percentage increase or decrease • **express one quantity as a percentage of another** ❖ • **simplify ratios including those given in different units** ❖ • use ratio and proportion to calculate quantities, **including cases where the 'total' is not given** ▲ • **add, subtract, multiply and divide fractions** ❖	• use equivalence of fractions, decimals, percentages **and ratio** to select the most appropriate for a calculation ▲ • use, interpret **and calculate with** different representations of fractions, *e.g. mixed numbers and improper fractions* ▲ • calculate a percentage increase or decrease • express one quantity as a percentage of another, **including those given in different units** ▲ • use ratio and proportion to calculate quantities, **including cases where the 'total' is not given** ▲

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Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using number skills	**Calculate using mental and written methods**	• use efficient written methods to add and subtract numbers with up to 2 decimal places • 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 • multiply and divide whole numbers by 0.5, 0.2, 0.1 • use the order of operations • **add and subtract with negative numbers using mental methods** ❖	• use efficient written methods to add and subtract numbers with up to 2 decimal places • use efficient methods for multiplication and division of whole numbers and decimals, including decimals such as 0.6 or 0.06 • use the order of operations including brackets • **multiply and divide with negative numbers using mental methods** ❖	• 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 • multiply and divide whole numbers and decimals • use the order of operations including brackets and powers • **use the four operations in multistep calculations involving negative numbers, using mental and written methods** ❖
	Estimate and check	• use a range of strategies to check calculations including the use of inverse operations, equivalent calculations and the rules of divisibility • use rounding to estimate answers • present answers to a given number of decimal places	• use rounding to estimate answers to a given number of significant figures • present answers to a given number of significant figures	• make and justify estimates and approximations of calculations • choose the appropriate degree of accuracy to present answers
	Manage money	• use profit and loss in buying and selling calculations • understand the advantages and disadvantages of using bank accounts, including bank cards • make informed decisions relating to discounts and special offers	• carry out calculations relating to VAT, saving and borrowing • appreciate the basic principles of budgeting, saving (including understanding compound interest) and borrowing • **calculate using foreign money and exchange rates** ❖	• calculate using foreign money and exchange rates • understand the risks involved in different ways of saving and investing • describe why insurance is important and understand the impact of not being insured

Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using measuring skills	**Length, weight/mass, capacity**	• find perimeters of shapes, **including compound shapes**, with straight sides ▲ • **make estimates of length, weight/mass and capacity based on familiar and less familiar objects** ❖ • read and interpret scales on a range of measuring instruments • convert between units of the metric system and carry out calculations • **understand that some measurements take particular values and others can take any value within a given range** ❖	• **find circumferences of circles** ❖ • use the common units of measure, convert between related units of the metric system and carry out calculations • use rough metric equivalents of imperial units in daily use • **recognise measurements that are discrete and those that are continuous** ❖ • **interpret conversion graphs** ❖	• find circumferences of circles **and perimeters of semicircles and quadrants** ▲ • **derive and use Pythagoras' theorem** ❖ • make links between speed, distance and time • **understand and use a variety of compound measures, including speed and density** ❖ • **define upper and lower bounds of discrete measurements** ❖ • **recognise that there are different considerations for continuous data** ❖
	Time	• measure and record time in hundredths of a second • **calculate start times, finish times and durations** ❖ • **convert between times expressed as a decimal or fraction and hours, minutes and seconds, *e.g. 1.5, 1.25, 1.75 hours*** ❖ • use time zones **to compare times in different countries** ▲	• interpret fractions of a second appropriately • **interpret time expressed as decimals and fractions and enter them appropriately on a calculator** ❖ • use timetables and time zones to calculate travel time **for a multi-stage journey** ▲	• **use timetables and time zones to plan a journey** ❖
	Temperature	• record temperatures in appropriate temperature scales	• convert temperatures between appropriate temperature scales	• convert temperatures between appropriate temperature scales

Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using measuring skills	**Area and volume** **Angle and position**	• **devise and** use formulae for the area of rectangles and triangles ▲ • **devise and use formulae to calculate the area of parallelograms** ❖ • **calculate areas of compound shapes (*e.g. consisting of rectangles and triangles*) and volumes of simple solids (*e.g. cubes and cuboids*)** ❖ • measure, draw **and label** angles **to the nearest degree, *e.g. angle ABC*** ▲ • **use knowledge of angle types to estimate angles** ❖ • **calculate angles on a straight line, around a point, vertically opposite and in triangles** ❖	• calculate areas of compound shapes (*e.g. consisting of rectangles and triangles*) and volumes of simple solids (*e.g. cubes and cuboids*) • **find areas of circles** ❖ • **devise and use formulae to calculate the area of trapezia and kites** ❖ • **calculate volumes of prisms constructed from cuboids, *e.g. within an L-shaped cross-section*** ❖ • **explore angles on parallel lines** ❖ • **understand exterior angles of triangles** ❖ • **know and use the angle properties of quadrilaterals** ❖ • **find horizontal and vertical distances using coordinates** ❖ • **use bearings to describe the location of one object in relation to another** ❖ • use compass bearings and grid references to specify location	• find areas of circles, **semicircles and quadrants** ▲ • **calculate surface areas of cubes and cuboids** ❖ • **calculate volumes of prisms and cylinders** ❖ • **calculate angles on parallel lines** ❖ • **calculate interior and exterior angles of polygons** ❖ • **draw the relative position of objects given the bearing of one from the other** ❖ • apply understanding of bearings and scale to interpret maps and plans, and to create plans and drawings to scale

Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using geometry skills	Shape	• make connections between nets and prisms and pyramids ❖ • define solid shapes by their properties using the terms edges, faces, vertices and prism ❖ • explain the properties of congruent shapes ❖ • identify a radius and diameter and use the relationship between them ❖ • identify a circumference ❖	• classify quadrilaterals ❖ • explore the tessellation of two shapes ❖ • recognise shapes that will or will not tessellate ❖	• recognise similar shapes and calculate the size of missing sides with whole number scale factor ❖ • explore properties of shapes that tessellate ❖
	Construction	• construct circles using compasses ❖ • recognise and draw to scale on square paper nets of cubes and cuboids ❖ • draw triangles accurately given lengths and angles, using ruler and protractor ❖	• recognise and draw accurate nets of prisms ❖ • represent 3D shapes on isometric paper and draw plans and elevations of 3D shapes made out of cubes ❖ • construct triangles given three lengths, using a ruler and compasses ❖ • identify sets of lengths that cannot form a triangle ❖	• select and use appropriate equipment to draw triangles when given sufficient angles and sides ❖
	Movement	• know the symmetrical properties of regular and irregular shapes ❖ • rotate a shape on a grid ❖ • translate a shape using a description, *e.g. 4 squares right and 2 squares down* ❖ • describe a translation ❖	• explore symmetrical properties of 3D shapes; identify planes of symmetry ❖ • enlarge shapes on square paper where the scale factor is a positive whole number ❖	• rotate shapes about the origin ❖ • describe rotations about the origin ❖ • enlarge a shape around a centre where the scale factor is positive ❖ • explore locus where the path is a given distance from a point, line or shape ❖

Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using algebra skills	Number sequences	• distinguish between a term to term rule and an nth term rule ❖ • explore number sequences ❖ • express nth term rules involving one and two steps in words and symbols ❖	• use algebra to express the nth term rule of a linear sequence ❖ • use the nth term rule to find particular terms ❖ • use the nth term rule to generate a sequence ❖	• use the nth term rule to determine whether a number is in a sequence ❖ • determine the position number of a given term ❖ • distinguish between a linear and non-linear sequence ❖
	Expressions and formulae	• show that a + b = b + a and a – b is not equal to b – a ❖ • show that a x b = b x a and $^{a}/_{b}$ is not equal to $^{b}/_{a}$ ❖ • know that 4g x 2h = 8gh ❖ • know that b divided by 2 is notated as $^{b}/_{2}$ and $^{1}/_{2}b$ ❖ • substitute positive whole numbers into one and two step expressions ❖ • simplify expressions involving the addition and subtraction of two or more variables ❖	• know that a x a = a^2 ❖ • know that 2a x a = $2a^2$ ❖ • substitute positive and negative whole numbers into one and two step expressions ❖ • simplify expressions involving the addition and subtraction of two or more variables, including those where one or more of the simplified variables is negative ❖ • expand a single bracket ❖ • rearrange formulae involving two variables ❖	• show and use rules that involve the multiplication, division and use of brackets with index variables ❖ • simplify expressions including expansion of a single bracket, including a(b + c) + d(e + f), and double brackets ❖ • factorise algebraic expressions of two or more terms into a single bracket where there is one common factor ❖ • rearrange formulae involving two or more variables ❖
	Functions and graphs	• express output generated from two (or more) step function machines, taking into account the order of operations using algebra ❖ • read, plot and write coordinates in all four quadrants ❖	• express output generated from function machines, taking into account the order of operations ❖ • generate and plot points for linear functions ❖	• examine features of linear functions, read an intercept from a graph, and recognise positive and negative gradients ❖ • recognise the impact of the coefficient of x on the gradient of the line ❖

Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using algebra skills	**Equations and inequalities**	• **solve two step equations ❖** • **express a set of numbers as a single inequality using < > ≤ ≥ ❖** • **give solutions for inequalities < > ≤ ≥, recognising that there are an infinite number of solutions ❖**	• **solve equations including those where the solution is a negative, a fraction or a decimal and those that include brackets ( ) ❖** • **give a set of solutions from an inequality with two boundaries and show them on a number line ❖** • **express a set of numbers as an inequality ❖** • **complete and interpret simple information and distance–time graphs, showing an understanding of gradients within the context of the question ❖**	• **construct and solve equations that include brackets ( ) and a( ) + b( ) ❖** • **construct and solve equations where the variable appears on both sides of the equals sign ❖** • **solve equations by trial and improvement and justify the solution ❖** • **express situations as inequalities ❖** • **solve inequalities and show the solutions on a number line ❖** • **construct and interpret information graphs that relate to a variety of situations, *e.g. running a bath* ❖**
Using data skills	**Collect and record data** **Present and analyse data** **Interpret results**	• collect own data for a survey, *e.g. through designing a questionnaire* • construct frequency tables for sets of data, grouped where appropriate, in equal class intervals (groups given to learners) • construct a wide range of graphs and diagrams to represent the data and reflect the importance of scale • interpret diagrams and graphs (including pie charts) • use mean, median, mode and range to compare two distributions (discrete data)	• plan how to collect data to test hypotheses • construct a wide range of graphs and diagrams to represent discrete and continuous data • construct frequency tables for sets of data in equal class intervals, selecting groups as appropriate • construct graphs to represent data including scatter diagrams to investigate correlation • interpret diagrams and graphs to compare sets of data • **find the mean, median, mode and range from ungrouped frequency tables ❖** • use mean, median, mode and range to compare two distributions (continuous data)	• test hypotheses, making decisions about how best to record and analyse the information from large data sets • construct and interpret graphs and diagrams (including pie charts) to represent discrete or continuous data, with the learner choosing an appropriate scale • select and justify statistics most appropriate to the problem considering extreme values (outliers) • examine results critically, select and justify choice of statistics recognising the limitations of any assumptions and their effect on the conclusions drawn • use appropriate mathematical instruments and methods to construct accurate drawings • **find the mean, median, mode and range from grouped frequency tables and explain why it is an estimate ❖**

Key Stage 3 Mathematics Programme of Study

Strands	Elements	Year 7 Learners are able to:	Year 8 Learners are able to:	Year 9 Learners are able to:
Using data skills	Probability	• recognise that impossible = 0 and certain = 1 and that the probability of an event will lie on a scale between 0 and 1 ❖ • express the probability of an event as a fraction or decimal percentage ❖ • give examples of events that have a probability of $^1/_2$ ❖ • determine events with two outcomes that are/aren't equally likely ❖ • record all the outcomes of two events as an exhaustive list ❖ • estimate the number of successes of an event, *e.g. flipping a coin ten times, how many heads would be expected?* ❖	• show that the sum of all probabilities = 1 ❖ • recognise that some outcomes cannot occur simultaneously, *e.g. a coin cannot show heads and tails at the same time* ❖ • know that events that have two outcomes are not necessarily equally likely ❖ • complete a sample space diagram and a two way table ❖ • estimate the number of successes of an event, *e.g. rolling a fair dice 300 times, how many 3s would be expected?* ❖	• use the sum of all probabilities is 1 – simple cases, *e.g. rolling a dice P (not 6)* ❖ • recognise that practice is different from theory and that repeated experiments may give different results ❖ • understand that reliability/stability increases with a greater number of trials ❖ • construct a sample space diagram and a two way table. ❖