Learning Ladder – Maths

Pupils are assessed across five strands and must meet three assessment objectives in all strands

AO1 Use and apply standard techniques

AO2 Reason, interpret and communicate mathematically

AO3 Solve problems within mathematics and in other contexts

Exam Criteria	Number and Algebra	Ratio, Proportion and rates of Change	Geometry	Statistics and Probability	Using and Applying
Grade W	Pupils count, order, combine, increase and decrease quantities when solving problems in practical contexts. They read and write the numbers involved. They recognise and use a half.		When working with 2-D and 3-D shapes, pupils use mathematical language to describe properties and positions. They measure and order objects using direct comparison, and order events.	Pupils sort objects and classify them, demonstrating the criterion they have used. They collect data to answer questions. They construct simple pictograms, tally charts and block diagrams	Pupils use mathematics as an integral part of classroom activities. They represent their work with objects or pictures and discuss it. They recognise and use simple patterns or relationships

Grade 0	Pupils count sets of objects reliably, and use mental recall of addition and subtraction facts to 20 and mental multiplication and division for 2, 5 and 10s. They begin to understand the place value of each digit in a number and use this to order numbers up to 100. They choose the appropriate operation when solving addition and subtraction problems. They know subtraction is the inverse of addition, and understand that multiplication is commutative. They solve calculations in multiplication and division within the multiplication tables. They recognise halves and quarters and apply them to small quantities. They recognise sequences of numbers, including odd and even numbers.		Pupils use mathematical names for common 3-D and 2-D shapes and describe their properties, including numbers of faces, edges and vertices. They distinguish between straight and turning movements, recognise angle as a measurement of turn, and right angles in turns. They begin to use every-day non-standard and standard units to measure length and mass.	Pupils sort objects and classify them using more than one criterion. When they have gathered information to answer a question or explore a situation, pupils record results in simple lists, tables, diagrams and bar charts, in order to communicate their findings.	Pupils select the mathematics they use in some classroom activities. They discuss their work using mathematical language and are beginning to represent it using symbols and simple diagrams. They explain why an answer is correct.

| Grade 1 | Pupils show understanding of place value in numbers up to 1000 and use this to make approximations. They use decimal notation in the context of measures and money, and recognise negative numbers in practical contexts such as temperature. Pupils use mental recall of addition and subtraction facts to 20 in solving problems involving larger numbers. They add and subtract numbers with two digits mentally and three digits using written methods. They use mental recall of the 2, 3, 4, 5, 8 and 10 multiplication tables and derive the associated division facts. They solve whole-number problems involving multiplication or division including those that give rise to remainders. They use simple fractions that are several parts of a whole and recognise when two simple fractions are equivalent. They solve simple missing number calculations using the 4 rules. | Pupils use the language of "in every" and "for every" when describing patterns. | Pupils classify 3-D and 2-D shapes in various ways using mathematical properties such as reflective symmetry for 2-D shapes. They recognise and use terms such as horizontal, vertical, parallel and perpendicular, and can classify angle types. They use non-standard units, standard metric units of length including finding perimeters, capacity and mass, and standard units of time, in a range of contexts. | Pupils extract and interpret information presented in simple tables and lists. They construct charts and diagrams to communicate information they have gathered for a purpose, and they interpret information presented to them in this form. Pupils understand and use basic language of likelihood. | Pupils try different approaches and find ways of overcoming difficulties that arise when they are solving problems. They are beginning to organise their work and check results. Pupils discuss their mathematical work and are beginning to explain their thinking. They use and interpret mathematical symbols and diagrams. Pupils show that they understand a general statement by finding particular examples that match it. |

| Grade 2 | Pupils use their understanding of place value to mentally multiply and divide whole numbers by 10 or 100. When solving number problems, they use a range of mental methods of computation with the four operations, including mental recall of multiplication facts up to 12 x 12 and quick derivation of corresponding division facts. They select efficient strategies for addition, subtraction, multiplication and division. They recognise approximate proportions of a whole and use simple fractions and percentages to describe these. They begin to use simple formulae expressed in words. They recognise properties of numbers including squares, factors and multiples. | Pupils solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts | Pupils use and make geometric 2-D and 3-D patterns, scale drawings and models in practical contexts. They reflect simple shapes in a mirror line and translate objects. They choose and use appropriate units and tools, interpreting, with appropriate accuracy, numbers on a range of measuring instruments. They find perimeters and areas of simple shapes. | Pupils generate and answer questions that require the collection of discrete data recording in a frequency table. They understand and use an average and range to describe sets of data. They group data in equal class intervals, represent collected data in frequency diagrams and interpret such diagrams. They construct and interpret simple line graphs. Pupils understand and use the probability scale. | Pupils develop their own strategies for solving problems and use them in mathematics, and in applying mathematics to practical contexts. When solving problems they check their results are reasonable by considering the context. They look for patterns and relationships, presenting information and results in a clear and organised way. They search for a solution by trying out ideas of their own. |

Grade 3	Pupils use their understanding of place value to multiply and divide whole numbers and decimals. They read, write, order, compare and round numbers up to a million. They order, add and subtract negative numbers in context. They use all four operations with decimals, fractions and percentages. They calculate fractional or percentage parts of quantities and measurements. They add and subtract fractions with common denominators, and recognise decimal and percentage equivalents. They construct, express in symbolic form and use simple formulae involving one or two operations. They use brackets appropriately and simplify simple algebraic expressions. They use and interpret coordinates in all four quadrants, and generate and describe arithmetic progressions.	Pupils use ratio notation, including reduction to simplest form. They divide a given quantity into two parts in a given part:part or part:whole ratios. They solve simple problems involving ratio and direct proportion.	Pupils measure and draw angles to the nearest degree and use the language of angles. They know the angle sum of a triangle, angles at a point and angles on a straight line. They identify all the symmetries of 2-D shapes. They can apply all the transformations. They convert one metric unit to another. They make sensible estimates of a range of measures in relation to everyday situations. They understand and use the formula for the area of a rectangle.	Pupils understand and use the mean of discrete data. They compare simple distributions using the range and an average. They interpret graphs and diagrams, including pie charts, and draw conclusions. They find and justify probabilities and approximations to these by selecting and using methods based on equally likely outcomes and experimental evidence, as appropriate. They understand that different outcomes may result from repeating an experiment.	In order to tackle problems or explore mathematical situations pupils identify the mathematical aspects and obtain necessary information. They calculate accurately, using ICT where appropriate. They check their working and results, considering whether these are sensible. They show understanding of situations by describing them mathematically using symbols, words and diagrams. They draw simple conclusions of their own and explain their reasoning.

| Grade 4 | Pupils order and approximate decimals when solving numerical problems and equations, using trial and improvement methods. They evaluate one number as a fraction or percentage of another. They understand and use the equivalences between fractions, decimals and percentages. They add and subtract fractions with different denominators, and multiply simple fractions. They find and describe in words the rule for the next term or nth term of a sequence where the rule is linear. They construct and solve linear equations with whole-number coefficients. They represent mappings expressed algebraically, use Cartesian coordinates to plot graphs, and understand y = mx + c as a straight line. | Pupils calculate using ratios in appropriate situations. They express the division of a quantity into two parts as a ratio; apply ratio to real contexts and problems (such as those involving conversion, comparison, scaling, mixing, concentrations). They solve proportional reasoning problems and express a multiplicative relationship between two quantities as a ratio or a fraction. | Pupils use common 2-D representations of 3-D objects. They know and use the properties of quadrilaterals. They solve problems using angle and symmetry, properties of polygons and angle properties of intersecting and parallel lines, and explain these properties. They enlarge shapes given a centre of enlargement and a positive scale factor. They understand and find the circumferences and areas of circles, areas of plane rectilinear figures and volumes of cuboids. They know the exact values of sin θ, cos θ and tan θ for θ = 0°, 30°, 45°, 60° and 90° Pupils understand and use congruence and mathematical similarity. They use sine, cosine and tangent in right-angled triangles when solving problems in two dimensions | Pupils collect and record continuous data, choosing equal class intervals to create frequency tables. They construct and interpret frequency diagrams and pie charts. They draw conclusions from scatter diagrams, and have a basic understanding of correlation. When dealing with a combination of two events, they identify all the outcomes. They use the total probability of all the mutually exclusive outcomes of an experiment is 1 to solve problems | Pupils carry out substantial tasks and solve quite complex problems by independently and systematically breaking them down into smaller, more manageable tasks. They interpret, discuss and synthesise information presented in a variety of mathematical forms, relating findings to the original context. Their written and spoken language explains and informs their use of diagrams. They begin to give mathematical justifications. |

Grade 5	When making estimates, pupils round to one significant figure and multiply and divide mentally. They understand the effects of multiplying and dividing by numbers between 0 and 1. They solve numerical problems involving multiplication and division with numbers of any size, using a calculator efficiently and appropriately. They find and describe in symbols the next term or nth term of a sequence where the rule is quadratic. They plot and use graphs of quadratic functions. They use algebraic and graphical methods to solve simultaneous linear equations in two variables.	Pupils understand and use proportional changes, calculating the result of any proportional change using only multiplicative methods. They understand and use compound measures, such as speed, unit pricing and density to solve problems. They use scale factors, scale diagrams and maps. They compare lengths, areas and volumes using ratio notation.	Pupils understand and apply Pythagoras' theorem when solving problems in 2-D. They calculate lengths, areas and volumes in plane shapes and right prisms. They enlarge shapes by a fractional scale factor, and appreciate the similarity of the resulting shapes. They determine the locus of an object moving according to a rule. They appreciate the imprecision of measurement. They use sine, cosine and tangent in right-angled triangles when solving problems in two dimensions.	Pupils specify hypotheses and test them by using appropriate methods that take account of variability/bias. They find the modal class and estimate the mean, median and range of sets of grouped data, selecting the statistic most appropriate to their line of enquiry. They use measures of average and range, with frequency polygons to compare distributions and make inferences. They understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.	Starting from problems or contexts that have been presented to them, pupils explore the effects of varying values and look for invariance in models and representations. They progressively refine or extend the mathematics used, giving reasons for their choice of mathematical presentation and explaining features they have selected. They justify their generalisations, arguments or solutions. They appreciate the difference between mathematical explanation and experimental evidence.

| Grade 6 | Pupils solve problems that involve calculating with powers, roots and numbers expressed in standard form, and calculate exactly with surds and π. They evaluate algebraic formulae or calculate one variable, given the others, substituting fractions, decimals and negative numbers. They manipulate algebraic formulae, equations and expressions, finding common factors and multiplying two linear expressions. They solve quadratic functions by factorisation. They solve inequalities in two variables. They sketch and interpret graphs of linear, quadratic, cubic and reciprocal functions, and graphs that model real situations. | Pupils choose to use fractions or decimals to solve problems involving repeated proportional changes or the calculation of the original quantity given the result of a proportional change. They make links to similarity, including trigonometric ratios and scale factors. | Pupils understand and use congruence and mathematical similarity. Pupils use Pythagoras' theorem to solve problems in 2-D /3-D | Pupils interpret and construct cumulative frequency tables and diagrams. They estimate the median and interquartile range and use these to compare distributions and make inferences. They understand how to calculate the probability of a compound event and use this in solving problems. | Pupils develop and follow alternative approaches. They compare and evaluate representations of a situation, using a range of mathematical techniques. They reflect on their own lines of enquiry. They communicate mathematical meaning through precise and consistent use of symbols. They examine generalisations or solutions and make progress in the activity as a result. They comment constructively on the reasoning and logic, the process employed and the results obtained. |

Grade 7	Pupils understand and use rational and irrational numbers. They determine the bounds of intervals. In simplifying algebraic expressions, they use rules of indices for negative and fractional values. In finding formulae that approximately connect data, they express general laws in symbolic form. They rationalise algebraic fractions involving surds.	Pupils understand that X is inversely proportional to Y is equivalent to X is proportional to 1/Y, and understand and use direct and inverse proportion.	They understand and apply the circle theorems to solve geometrical problems. They construct formal geometric proofs. They calculate lengths of circular arcs and areas of sectors. They appreciate the continuous nature of measurements. They use vectors to solve simple problems.	Pupils understand how different methods of sampling and different sample sizes may affect the reliability of conclusions drawn. They select and justify a sample and method, including estimating populations by using the capture/recapture method.	Pupils critically examine the strategies adopted when investigating within mathematics itself or when using mathematics to analyse tasks. They explain why different strategies were used, considering the elegance and efficiency of alternative lines of enquiry or procedures.
Grade 8	Pupils solve simultaneous equations in two variables where one equation is linear and the other is quadratic. They prove algebraic results with rigorous and logical mathematical arguments. They solve problems using intersections and gradients of graphs. They work with general iterative processes. Pupils expand two or more binomials.	Pupils interpret equations that describe direct and inverse proportion. and recognise and interpret graphs that illustrate direct and inverse proportion.	Pupils sketch the graphs of sine, cosine and tangent functions for any angle, and generate and interpret graphs based on these functions. They use sine, cosine and tangent of angles of any size. They calculate the surface area of cylinders and volumes of cones and spheres. .	Pupils interpret and construct histograms with unequal intervals. They estimate the median, mean and quartiles on a histogram with unequal intervals. They recognise when and how to work with probabilities associated with independent, mutually exclusive events. Pupils construct equations that describe direct and inverse proportion	Pupils apply the mathematics they know in a wide range of familiar and unfamiliar contexts. They use mathematical language and symbols effectively in presenting a convincing, reasoned argument. Their reports include mathematical justifications, distinguishing between evidence and proof and explaining their solutions to problems involving a number of features or variables.

Grade 9	They interpret the reverse process as the 'inverse function'; interpret the succession of two functions as a 'composite function'. They interpret the gradient at a point on a curve as the instantaneous rate of change and apply the concepts of average and instantaneous rate of change in numerical, algebraic and graphical contexts. They find approximate solutions to equations numerically using iteration.	They set up, solve and interpret the answers in growth and decay problems, including compound interest	They use vectors to solve more complex geometrical problems.	They interpret the gradient at a point on a curve as the instantaneous rate of change; apply the concepts of average and instantaneous rate of change (gradients of chords and tangents) in numerical, algebraic and graphical contexts.	Pupils prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results. They use vectors to construct geometric arguments and proofs.