






## **Assumed Knowledge for GCE Mathematics**



The GCE Mathematics specifications written for first teaching in September 2004 were designed at a time when GCSE Mathematics had three tiers: Foundation, Intermediate and Higher. The subject criteria for GCE Mathematics were designed with the assumption that students embarking on AS and Advanced GCE study in Mathematics were expected to have achieved at least grade C in GCSE Mathematics, or its equivalent, and to have covered all the material in the Intermediate Tier of GCSE Mathematics; Intermediate Tier of GCSE Mathematics allowed candidates to achieve up to grade B.

This document contains the content of a three-tier GCSE Mathematics specification in use in 2004. The document is laid out in double pages, so that pages 1 and 2 form one double-page spread. The assumed knowledge for GCE Mathematics can therefore be found on the odd-numbered pages, though there are relevant notes in the right-hand column of the even-numbered pages.





AO2 Number and Algebra	NC ref	Foundation Tier	NC ref	Intermediate Tier
<b>1. Using and applying Number and Algebra</b>				
		pupils should be taught to:		pupils should be taught to:
<b>Problem Solving</b>	F2.1a	select and use suitable problem-solving strategies and efficient techniques to solve numerical and algebraic problems	H2.1a	select and use appropriate and efficient techniques and strategies to solve problems of increasing complexity, involving numerical and algebraic manipulation
			H2.1b	identify what further information may be required in order to pursue a particular line of enquiry and give reasons for following or rejecting particular approaches
	F2.1b	break down a complex calculation into simpler steps before attempting to solve it	H2.1c	..... and justify their choice of methods
	F2.1c	use algebra to formulate and solve a simple problem - identifying the variable, setting up an equation, solving the equation and interpreting the solution in the context of the problem		
	F2.1d	make mental estimates of the answers to calculations; use checking procedures, including use of inverse operations; work to stated levels of accuracy	H2.1d	make mental estimates of the answers to calculations; present answers to sensible levels of accuracy; understand how errors are compounded in certain calculations
<b>Communicating</b>	F2.1e	interpret and discuss numerical and algebraic information presented in a variety of forms	H2.1e	discuss their work and explain their reasoning using an increasing range of mathematical language and notation
	F2.1f	use notation and symbols correctly and consistently within a given problem	H2.1h	.....
	F2.1g	use a range of strategies to create numerical, algebraic or graphical representations of a problem and its solution	H2.1f	use a variety of strategies and diagrams for establishing algebraic or graphical representations of a problem and its solution; move from one form of representation to another to get different perspectives on the problem
	F2.1h	present and interpret solutions in the context of the original problem	H2.1g	.....
			H2.1i	examine critically, improve, then justify their choice of mathematical presentation
<b>Reasoning</b>	F2.1j	explore, identify, and use pattern and symmetry in algebraic contexts, investigating whether particular cases can be generalised further, and understanding the importance of a counter-example (1)	H2.1j	..... identify exceptional cases when solving problems
			H2.1k	understand the difference between a practical demonstration and a proof
	F2.1k	show step-by-step deduction in solving a problem	H2.1l	.....
			H2.1m	recognise the significance of stating constraints and assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying the assumptions may have on the solution to a problem
<b>2. Numbers and the number system</b>				
<b>Integers</b>	F2.2a	use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10; understand and use positive numbers, both as positions and translations on a number line; order integers; use the concepts and vocabulary of factor (divisor), multiple and common factor	H2.2a	use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10; understand and use negative integers both as positions and translations on a number line; order integers; use the concepts and vocabulary of factor (divisor), multiple, common factor, highest common factor, least common multiple, prime number and prime factor decomposition
<b>Powers and roots</b>	F2.2b	use the terms square, positive square root, cube; use index notation for squares, cubes and powers of 10	H2.2b	..... use the terms negative square root, cube and cube root; use index notation (1) and index laws for multiplication and division of integer powers; use standard index form, expressed in conventional notation and on a calculator display

NC ref	Higher Tier		Key Skills and notes
<b>1. Using and applying Number and Algebra</b>			
	pupils should be taught to:		
H2.1a	.....		PS1.1, PS2.1
H2.1b	.....		PS1.2, PS2.2
H2.1e	.....		
H2.1f	move from one form of representation to another to get different perspectives on the problem		N1.3, PS1.1,
			C1.3, N1.3, PS1.3
H2.1i	..... present a concise, reasoned argument		PS1.1, PS2.3, C1.3
H2.1j	understand the importance of a counter-example; identify exceptional cases when solving problems		Foundation: (1)[for example, using simple codes that substitute numbers for letters]
H2.1k	.....		
H2.1l	derive proofs using short chains of deductive reasoning		
H2.1m	.....		
<b>2. Numbers and the number system</b>			
H2.2a	use the concepts and vocabulary of highest common factor, least common multiple, prime number and prime factor decomposition		
H2.2b	use index laws for multiplication and division of integer powers; use standard index form, expressed in conventional notation and on a calculator display		Intermediate : (1)[for example, $8^2$ , $8^{-2/3}$ ]

AO2 Number and Algebra	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>Fractions</b>	F2.2c	understand equivalent fractions, simplifying a fraction by cancelling all common factors; order fractions by rewriting them with a common denominator	H2.2c	.....
<b>Decimals</b>	F2.2d	use decimal notation and recognise that each terminating decimal is a fraction (1); order decimals	H2.2d	..... ; recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals (2)
<b>Percentages</b>	F2.2e	understand that 'percentage' means 'number of parts per 100' and use this to compare proportions; interpret percentage as the operator 'so many hundredths of' (1); use percentage in real-life situations (2)	H2.2e	understand that 'percentage' means 'number of parts per 100' and interpret percentage as the operator 'so many hundredths of' (1)
<b>Ratio</b>	F2.2f	use ratio notation, including reduction to its simplest form and its various links to fraction notation (1)	H2.2f	.....
<b>3. Calculations</b>				
<b>Number operations and the relationships between them</b>	F2.3a	add, subtract, multiply and divide integers and then any number; multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1	H2.3a	multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1; find the prime factor decomposition of positive integers; understand 'reciprocal' as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, because division by zero is not defined); multiply and divide by a negative number; use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer powers; use inverse operations
	F2.3b	use brackets and hierarchy of operations	H2.3b	.....
	F2.3c	calculate a given fraction of a given quantity, (1) expressing the answer as a fraction; express a given number as a fraction of another; add and subtract fractions by writing them with a common denominator; perform short division to convert a simple fraction to a decimal	H2.3c	..... ; distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by terminating decimals), and other fractions (which are represented by recurring decimals)
	F2.3d	understand and use unit fractions as multiplicative inverses (1)(2); multiply and divide a fraction by an integer, and multiply a fraction by a unit fraction	H2.3d	..... , and by a general fraction
	F2.3e	convert simple fractions of a whole to percentages of the whole and vice versa (1)	H2.3e	..... understand the multiplicative nature of percentages as operators (2); calculate an original amount when given the transformed amount after a percentage change; reverse percentage problems (3)
	F2.3f	divide a quantity in a given ratio (1)	H2.3f	.....
<b>Mental methods</b>	F2.3g	recall all positive integer complements to 100 (1); recall all multiplication facts to $10 \times 10$ , and use them to derive quickly the corresponding division facts; recall the cubes of 2, 3, 4, 5 and 10, and the fraction-to-decimal conversion of familiar simple fractions (2)	H2.3g	recall integer squares from $2 \times 2$ to $15 \times 15$ and the corresponding square roots, the cubes of 2, 3, 4, 5 and 10




NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
H2.2d	recognise that recurring decimals are exact fractions, and that some exact fractions are recurring decimals (2)		Foundation and Intermediate: (1)[for example, $0.137 = 137/1000$ ] Intermediate and Higher : (2)[for example, $1/7 = 0.142857142857\dots$ ]
			Foundation and Intermediate: (1)[for example, 10% means 10 parts per 100 and 15% of Y means $15/100 \times Y$ ] Foundation : (2)[for example, commerce and business, including rate of inflation, VAT and interest rates] Foundation Tier : Financial capability
H2.2f	.....		Foundation: (1) [for example, in maps and scale drawings, paper size and gears]
<b>3. Calculations</b>			
H2.3a	multiply or divide any number by a number between 0 and 1; find the prime factor decomposition of positive integers; understand 'reciprocal' as multiplicative inverse, knowing that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, because division by zero is not defined); multiply and divide by a negative number; use index laws to simplify and calculate the value of numerical expressions involving multiplication and division of integer, fractional and negative powers; use inverse operations, understanding that the inverse operation of raising a positive number to power $n$ is raising the result of this operation to power $1/n$		N1.2, N2.2
H2.3c	distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by recurring decimals); convert a recurring decimal to a fraction (2)		Foundation : (1) [for example, for scale drawings and construction of models, down payments, discounts] Higher : (2)[for example, $0.142857142857\dots = 1/7$ ]
H2.3d	multiply and divide a given fraction by a unit fraction and by a general fraction (2)		Foundation and Intermediate :(1) [for example, by thinking of multiplication by $1/5$ as division by 5] Foundation , Intermediate and Higher :(2) for example, by thinking of multiplication by $6/7$ as multiplication by 6 followed by division by 7 (or vice versa)]
H2.3e	understand the multiplicative nature of percentages as operators (2); calculate an original amount when given the transformed amount after a percentage change; reverse percentage problems (3)		Foundation : (1)[for example, analysing diets, budgets or the costs of running, maintaining and owning a car] Intermediate and Higher : (2)[for example, a 15% increase in value Y, followed by a 15% decrease is calculated as $1.15 \times 0.85 \times Y$ ]; (3)[for example, given that a meal in a restaurant costs £36 with VAT at 17.5%, its price before VAT is calculated as $£36/1.175$ ]
H2.3f	.....		Foundation : (1)[for example, share £15 in the ratio of 1:2]
H2.3g	..... the fact that $n^0 = 1$ and $n^{-1} = 1/n$ for positive integers $n$ (2), the corresponding rule for negative numbers (3), $n^{1/2} = \sqrt{n}$ and $n^{1/3} = \sqrt[3]{n}$ for any positive number $n$ (4)		Foundation : (1)[for example, $37 + 63 = 100$ ]; (2)[for example, $1/2, 1/4, 1/5, 1/10, 1/100, 1/3, 2/3, 1/8$ ] Higher : (2) [for example, $10^0 = 1; 9^{-1} = 1/9$ ], (3)[for example, $5^{-2} = 1/5^2 = 1/25$ ], (4)[for example, $25^{1/2} = 5$ and $64^{1/3} = 4$ ]

AO2 Number and Algebra	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
	F2.3h	round to the nearest integer and to one significant figure; estimate answers to problems involving decimals	H2.3h	round to a given number of significant figures; develop a range of strategies for mental calculation; derive unknown facts from those they know; convert between ordinary and standard index form representations (1), converting to standard index form to make sensible estimates for calculations involving multiplication and/or division
	F2.3i	develop a range of strategies for mental calculation; derive unknown facts from those they know (1); add and subtract mentally numbers with up to two decimal places (2); multiply and divide numbers with no more than one decimal digit (3), using the commutative, associative, and distributive laws and factorisation where possible, or place value adjustments		
<b>Written methods</b>	F2.3j	use standard column procedures for addition and subtraction of integers and decimals		
	F2.3k	use standard column procedures for multiplication of integers and decimals, understand where to position the decimal point by considering what happens if they multiply equivalent fractions		
	F2.3l	use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer	H2.3i	.....
	F2.3m	solve simple percentage problems, including increase and decrease (1)	H2.3j	solve percentage problems, including percentage increase and decrease (2); and reverse percentages
	F2.3n	solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution (1)	H2.3k	represent repeated proportional change using a multiplier raised to a power (2)
			H2.3l	calculate an unknown quantity from quantities that vary in direct proportion
			H2.3m	calculate with standard index form (1)
			H2.3n	use surds and $\pi$ in exact calculations, without a calculator
<b>Calculator methods</b>	F2.3o	use calculators effectively: know how to enter complex calculations and use function keys for reciprocals, squares and powers	H2.3o	use calculators effectively and efficiently, knowing how to enter complex calculations; use an extended range of function keys, including trigonometrical and statistical functions relevant across this programme of study
	F2.3p	enter a range of calculations, including those involving measures (1)	H2.3p	understand the calculator display, knowing when to interpret the display, when the display has been rounded by the calculator, and not to round during the intermediate steps of a calculation
	F2.3q	understand the calculator display (1), interpreting it correctly and knowing not to round during the intermediate steps of a calculation		
			H2.3r	use standard index form display and know how to enter numbers in standard index form
			H2.3s	use calculators for reverse percentage calculations by doing an appropriate division




NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
H2.3h	round to a given number of significant figures; convert between ordinary and standard index form representations, converting to standard index form to make sensible estimates for calculations involving multiplication and/or division		Intermediate/Higher : (1)[for example, $0.1234 = 1.234 \times 10^{-1}$ ] N1.2, N2.2
			Foundation : (1)[for example, estimate $\sqrt{85}$ ]; (2)[for example, $13.76 - 5.21$ , $20.08 + 12.4$ ]; (3)[for example, $14.3 \times 4$ , $56.7 \div 7$ ]
H2.3j	solve percentage problems; and reverse percentages		Foundation : (1)[for example, VAT, annual rate of inflation, income tax, discounts] Intermediate/Higher : (2)[for example, simple interest, VAT, annual rate of inflation] All tiers: Financial capability
H2.3k	.....		Foundation : (1)[for example, given that $m$ identical items cost $\pounds y$ , then one item costs $\pounds y/m$ and $n$ items cost $\pounds(n \times y/m)$ , the number of items that can be bought for $\pounds z$ is $z \times m/y$ ] Intermediate/Higher : (2)[for example, compound interest] N1.2, N2.2
H2.3l	calculate an unknown quantity from quantities that vary in direct or inverse proportion		N1.2, N2.2
H2.3m	.....		Intermediate/Higher : (1) [for example, $2.4 \times 10^7 \times 5 \times 10^3 = 12 \times 10^{10} = 1.2 \times 10^{11}$ ; $(2.4 \times 10^7) \div (5 \times 10^3) = 4.8 \times 10^3$ ]
H2.3n	..... rationalise a denominator such as $1/\sqrt{3} = \sqrt{3}/3$		
H2.3o	.....		
			Foundation : (1)[for example, time calculations in which fractions of an hour must be entered as fractions or as decimals]
H2.3q	use calculators, or written methods, to calculate the upper and lower bounds of calculations, particularly when working with measurements		Foundation : (1) [for example, in money calculations, or when the display has been rounded by the calculator]
H2.3r	.....		
H2.3s	.....		

AO2 Number and Algebra	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>4. Solving numerical problems</b>				
	F2.4a	draw on their knowledge of the operations and the relationships between them, and of simple integer powers and their corresponding roots, to solve problems involving ratio and proportion, a range of measures, including speed, metric units, and conversion between metric and common imperial units, set in a variety of contexts	H2.4a	draw on their knowledge of operations and inverse operations (including powers and roots), and of methods of simplification (including factorisation and the use of the commutative, associative and distributive laws of addition, multiplication and factorisation) in order to select and use suitable strategies and techniques to solve problems and word problems, including those involving ratio and proportion, repeated proportional change, fractions, percentages and reverse percentages, surds, measures and conversion between measures, and compound measures defined within a particular situation
	F2.4b	select appropriate operations, methods and strategies to solve number problems, including trial and improvement where a more efficient method to find the solution is not obvious		
	F2.4c	use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude		
	F2.4d	give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display, and recognising limitations on the accuracy of data and measurements	H2.4b	check and estimate answers to problems; select and justify appropriate degrees of accuracy for answers to problems; recognise limitations on the accuracy of data and measurements
<b>5. Equations, formulae and identities</b>				
<b>Use of symbols</b>	F2.5a	distinguish the different roles played by letter symbols in algebra, knowing that letter symbols represent definite unknown numbers in equation (1), defined quantities or variables in formulae (2), general, unspecified and independent numbers in identities (3) and in functions they define new expressions or quantities by referring to known quantities (4)	H2.5a	distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number, and knowing that letter symbols represent definite unknown numbers in equations (5), defined quantities or variables in formula (6), general, unspecified and independent numbers in identities (7), and in functions they define new expressions or quantities by referring to known quantities (8)
	F2.5b	understand that the transformation of algebraic expressions obeys and generalises the rules of arithmetic; manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out single term common factors (1)	H2.5b	understand that the transformation of algebraic entities obeys and generalises the well-defined rules of generalised arithmetic (2) expand the product of two linear expressions (3); manipulate algebraic expressions by collecting like terms, multiplying a single term over a bracket, taking out common factors (4), factorising quadratic expressions including the difference of two squares (5) and cancelling common factors in rational expressions (6)
			H2.5c	know the meaning of and use the words 'equation', 'formula', 'identity' and 'expression'










NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
H2.3t	use calculators to explore exponential growth and decay (1), using a multiplier and the power key		Higher : (1)[for example, in science or geography]
<b>4. Solving numerical problems</b>			
H2.4a	..... (solve problems and word problems involving) inverse proportion		N1.2, N2.2
			N1.2, N2.2
H2.4b	.....		N1.2, N2.2
<b>5. Equations, formulae and identities</b>			
H2.5a	.....		Foundation : (1)[for example, $5x + 1 = 16$ ] ;(2)[for example, $V = IR$ ], (3)[for example, $3x + 2x = 5x$ for all values of $x$ ] ; (4)[for example, $y = 2x$ ] Intermediate/Higher : (5)[for example, $x^2 + 1 = 82$ ], (6)[for example, $V = IR$ ], (7)[for example, $(x + 1)^2 = x^2 + 2x + 1$ for all values of $x$ ], (8)[for example, $y = 2 - 7x$ ; $f(x) = x^3$ ; $y = 1/x$ with $x \neq 0$ ]
H2.5b	.....		Foundation : (1)[for example, $x + 5 - 2x - 1 = 4 - x$ ; $5(2x + 3) = 10x + 15$ ; $x^2 + 3x = x(x + 3)$ ] Intermediate/Higher : (2) [for example, $a(b + c) = ab + ac$ ]; (3)[for example, $(x + 1)(x + 2) = x^2 + 3x + 2$ ]; (4)[for example, $9x - 3 = 3(3x - 1)$ ]; (5)[for example, $x^2 - 9 = (x + 3)(x - 3)$ ]; (6)[for example, $2(x + 1)^2/(x + 1) = 2(x + 1)$ ]
H2.5c	.....		









AO2 Number and Algebra	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>Index notation</b>	F2.5c	use index notation for simple integer powers, and substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$	H2.5d	use index notation for simple integer powers, and simple instances of index laws (1); substitute positive and negative numbers into expressions such as $3x^2 + 4$ and $2x^3$
<b>Equations</b>			H2.5e	set up simple equations (1); solve simple equations (2) by using inverse operation or by transforming both sides in the same way
<b>Linear equations</b>	F2.5e	solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation; solve linear equations that require prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution	H2.5f	solve linear equations in one unknown, with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation; solve linear equations that required prior simplification of brackets, including those that have negative signs occurring anywhere in the equation, and those with a negative solution
<b>Formulae</b>	F2.5f	use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols (1); substitute numbers into a formula; derive a formula (2)	H2.5g	use formulae from mathematics and other subjects (3); substitute numbers into a formula; change the subject of a formula, including cases where the subject occurs twice, or where a power of the subject appears (4); generate a formula (5)
<b>Direct and Inverse Proportion</b>				
<b>Simultaneous linear equations</b>			H2.5i	find the exact solution of two simultaneous equations in two unknowns by eliminating a variable, and interpret the equations as lines and their common solution as the point of intersection
<b>Inequalities</b>	F2.5d	solve simple linear inequalities in one variable, and represent the solution set on a number line	H2.5j	..... solve several linear inequalities in two variables and find the solution set
<b>Quadratic equations</b>			H2.5k	solve quadratic equations by factorisation
<b>Simultaneous linear and quadratic equations</b>				
<b>Numerical methods</b>			H2.5m	use systematic trial and improvement to find approximate solutions of equations where there is no simple analytical method of solving them (1)

NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
H2.5d	use simple instances of index laws (1)		Intermediate/Higher : (1)[for example, $x^2 \times x^3 = x^5$ ; $x^2 \div x^3 = x^{-1}$ ; $(x^2)^3 = x^6$ ];
H2.5e	.....		Intermediate/Higher : (1)[for example, find the angle $a$ in a triangle with angles $a$ , $a + 10$ , $a + 20$ ]; (2)[for example, $5x = 7$ ; $11 - 4x = 2$ ; $3(2x + 1) = 8$ ; $2(1 - x) = 6(2 + x)$ ; $4x^2 = 49$ ; $3 = 12/x$ ]
H2.5f	solve linear equations in one unknown, with integer or fractional coefficients, in which the unknown appears on either side or on both sides of the equation		
H2.5g	.....	  	Foundation : (1)[for example, formulae for the area of a triangle, the area enclosed by a circle, wage earned = hours worked $\times$ rate per hour]; (2)[for example, convert temperatures between degrees Fahrenheit and degrees Celsius, find the perimeter of a rectangle given its area $A$ and length $l$ of one side] Intermediate/Higher : (3)[for example, for area of a triangle or a parallelogram, area enclosed by a circle, volume of a prism, volume of a cone]; (4)[for example, find $r$ given that $A = \pi r^2$ , find $x$ given $y = mx + c$ ]; (5)[for example, find the perimeter of a rectangle given its area $A$ and the length $l$ of one side] N2.2, IT1.2, IT2.2 Foundation Tier : Pupils could use a spreadsheet to construct formulae to model situations. Intermediate/Higher Tiers: Pupils could use a spreadsheet or graphic calculator to construct and use formulae.
H2.5h	set up and use equations to solve word and other problems involving direct proportion or inverse proportion and relate algebraic solutions to graphical representation of the equations (1)		Higher : (1) [for example, $y \propto x$ , $y \propto x^2$ , $y \propto 1/x$ , $y \propto 1/x^2$ ]
H2.5i	.....		
H2.5j	.....		
H2.5k	solve quadratic equations by factorisation, completing the square and using the quadratic formula		
H2.5l	solve exactly, by elimination of an unknown, two simultaneous equations in two unknowns, one of which is linear in each unknown, and the other is linear in one unknown and quadratic in the other (1), or where the second is of the form $x^2 + y^2 = r^2$		Higher : (1) [for example, $y = 11x - 2$ and $y = 5x^2$ ]
H2.5m	.....		Intermediate/Higher : (1) [for example, $x^3 = x - 900$ ]

AO2 Number and Algebra	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>6. Sequences, functions and graphs</b>				
<b>Sequences</b>	F2.6a	generate terms of a sequence using term-to-term and position-to-term definitions of the sequence	H2.6a	generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers); generate terms of a sequence using term-to-term and position-to-term definitions of the sequence; use linear expressions to describe the $n$ th term of an arithmetic sequence, justifying its form by reference to the activity or context from which it was generated
<b>Graphs of linear functions</b>	F2.6b	use the conventions for coordinates in the plane; plot points in all four quadrants; plot graphs of functions in which $y$ is given explicitly in terms of $x$ (1) or implicitly (2)	H2.6b	use conventions for coordinates in the plane; plot points in all four quadrants; recognise (when values are given for $m$ and $c$ ) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane; plot graphs of functions in which $y$ is given explicitly in terms of $x$ (1), or implicitly (2)
	F2.6c	construct linear functions from real-life problems and plot their corresponding graphs; discuss and interpret graphs arising from real situations	H2.6c	find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for $m$ and $c$ ); understand that the form $y = mx + c$ represents a straight line and that $m$ is the gradient of the line, and $c$ is the value of the $y$ -intercept; explore the gradients of parallel lines (1)
<b>Interpreting graphical information</b>	F2.6e	interpret information presented in a range of linear and non-linear graphs (1)	H2.6d	construct linear functions and plot the corresponding graphs arising from real-life problems; discuss and interpret graphs modelling real situations (2)
<b>Quadratic functions</b>			H2.6e	generate points and plot graphs of simple quadratic functions(1), then more general quadratic functions (2); find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function
<b>Other functions</b>			H2.6f	plot graphs of: simple cubic functions (1), the reciprocal function $y = 1/x$ with $x \neq 0$ , using a spreadsheet or graph plotter as well as pencil and paper; recognise the characteristic shapes of all these functions
<b>Transformation of functions</b>				
<b>Loci</b>			H2.6h	construct the graphs of simple loci

NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>6. Sequences, functions and graphs</b>			
H2.6a	generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers); use linear expressions to describe the $n$ th term of an arithmetic sequence, justifying its form by reference to the activity or context from which it was generated		
H2.6b	recognise (when values are given for $m$ and $c$ ) that equations of the form $y = mx + c$ correspond to straight-line graphs in the coordinate plane	  	Foundation/Intermediate : (1)[for example, $y = 2x + 3$ ], (2) [for example, $x + y = 7$ ] Foundation : Pupils could use a spreadsheet to calculate points and to draw graphs to explore the effects of varying $m$ and $c$ in the graph of $y = mx + c$ . Intermediate/Higher : Pupils could generate functions from plots of experimental data using simple curve fitting techniques on graphic calculators or with graphics software. IT1.2, IT2.2
H2.6c	..... and lines perpendicular to these lines (2)		Intermediate/Higher : (1)[for example, know that the lines represented by the equations $y = -5x$ and $y = 3 - 5x$ are parallel, each having gradient (-5) and that (2) the line with equation $y = x/5$ is perpendicular to these lines and has gradient 1/5]
H2.6d	.....		Foundation : (1) [for example, graphs describing trends, conversion graphs, distance-time graphs, graphs of height or weight against age, graphs of quantities that vary against time, such as employment] Intermediate/Higher : (2) [for example, distance-time graph for a particle moving with constant speed, the depth of water in a container as it empties, the velocity-time graph for a particle moving with constant acceleration] C1.2, N2.1
H2.6e	..... find the intersection points of the graphs of a linear and quadratic function, knowing that these are the approximate solutions of the corresponding simultaneous equations representing the linear and quadratic functions		Intermediate/Higher : (1) [for example, $y = x^2$ ; $y = 3x^2 + 4$ ], (2) [for example, $y = x^2 - 2x + 1$ ]
H2.6f	..... plot graphs of: the exponential function $y = k^x$ for integer values of $x$ and simple positive values of $k$ (2), the circular functions $y = \sin x$ and $y = \cos x$ , using a spreadsheet or graph plotter as well as pencil and paper; recognise the characteristic shapes of all these functions		Intermediate/Higher : (1) [for example, $y = x^3$ ], Higher : (2) [for example, $y = 2^x$ ; $y = (\frac{1}{2})^x$ ]  IT1.1, IT1.2, IT2.2
H2.6g	apply to the graph of $y = f(x)$ the transformations $y = f(x) + a$ , $y = f(ax)$ , $y = f(x + a)$ , $y = af(x)$ for linear, quadratic, sine and cosine functions $f(x)$	 	Higher : Pupils could use software to explore transformations of graphs.  IT2.2
H2.6h	..... including the circle $x^2 + y^2 = r^2$ for a circle of radius $r$ centred at the origin of coordinates; find graphically the intersection points of a given straight line with this circle and know that this corresponds to solving the two simultaneous equations representing the line and the circle		

AO3 Shape, space and measures	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>1. Using and Applying shape, space and measures</b>				
<b>Problem solving</b>	F3.1a	select problem-solving strategies and resources, including ICT tools, to use in geometrical work, and monitor their effectiveness	H3.1a	select the problem-solving strategies to use in geometrical work, and consider and explain the extent to which the selections they made were appropriate
	F3.1b	select and combine known facts and problem-solving strategies to solve complex problems	H3.1b	select and combine known facts and problem-solving strategies to solve more complex geometrical problems
	F3.1c	identify what further information is needed to solve a geometrical problem; break complex problems down into a series of tasks	H3.1c	develop and follow alternative lines of enquiry
<b>Communicating</b>	F3.1d	interpret, discuss and synthesise geometrical information presented in a variety of forms	H3.1d	communicate mathematically, with emphasis on a critical examination of the presentation and organisation of results, and on effective use of symbols and geometrical diagrams
	F3.1e	communicate mathematically, by presenting and organising results and explaining geometrical diagrams		review and justify their choices of mathematics presentation ;
	F3.1f	use geometrical language appropriately		
<b>Reasoning</b>	F3.1i	apply mathematical reasoning, explaining and justifying inferences and deductions	H3.1f	apply mathematical reasoning, progressing from brief mathematical explanations towards full justifications in more complex contexts
			H3.1g	explore connections in geometry; pose conditional constraints of the type 'If ... then ...'; and ask questions 'What if ...?' or 'Why?'
	F3.1j	show step-by-step deduction in solving a geometrical problem	H3.1h	.....
			H3.1i	state constraints and give starting points when making deductions
<b>2. Geometrical reasoning</b>				
<b>Angles</b>	F3.2a	recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex		
	F3.2b	distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees		
<b>Properties of triangles and other rectilinear shapes</b>	F3.2c	use parallel lines, alternate angles and corresponding angles; understand the properties of parallelograms and a proof that the angle sum of a triangle is 180 degrees; understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices	H3.2a	distinguish between lines and line segments; use parallel lines, alternate angles and corresponding angles; understand the consequent properties of parallelograms and a proof that the angle sum of a triangle is 180 degrees; understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices


NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>1. Using and Applying shape, space and measures</b>			
H3.1a	.....	 	IT1.2, PS1.1, PS2.1
H3.1b	.....		PS1.2, PS2.2
H3.1c	develop and follow alternative lines of enquiry, justifying their decisions to follow or reject particular approaches		PS1.2, PS1.3, PS2.2, PS2.3
H3.1d	.....		C1.2,
H3.1e	use precise formal language and exact methods for analysing geometrical configurations		C1.3
H3.1f	.....		C1.3, PS1.3, PS2.3
H3.1g	.....		
			PS1.3, PS2.3
H3.1i	.....		
H3.1j	understand the necessary and sufficient conditions under which generalisations, inferences and solutions to geometrical problems remain valid		
<b>2. Geometrical reasoning</b>			
H3.2a	distinguish between lines and line segments		

<b>AO3 Shape, space and measures</b>	<b>NC ref</b>	<b>Foundation Tier</b>	<b>NC ref</b>	<b>Intermediate Tier</b>
		pupils should be taught to:		pupils should be taught to:
	F3.2d	use angle properties of equilateral, isosceles and right-angled triangles; understand congruence; explain why the angle sum of any quadrilateral is 360 degrees	H3.2b	use angle properties of equilateral, isosceles and right-angled triangles; explain why the angle sum of a quadrilateral is 360 degrees
	F3.2e	use their knowledge of rectangles, parallelograms and triangles to deduce formulae for the area of a parallelogram, and a triangle, from the formula for the area of a rectangle		
	F3.2f	recall the essential properties of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; classify quadrilaterals by their geometric properties	H3.2c	recall the definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; classify quadrilaterals by their geometric properties
	F3.2g	calculate and use the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons; calculate and use the angles of regular polygons	H3.2d	.....
			H3.2f	understand, recall and use Pythagoras' theorem in 2-D problems; investigate the geometry of cuboids including cubes, and shapes made from cuboids
			H3.2g	understand similarity of triangles and of other plane figures, and use this to make geometric inferences; understand, recall and use trigonometrical relationships in right-angled triangles, and use these to solve problems, including those involving bearings
<b>Properties of circles</b>	F3.2i	recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc; understand that inscribed regular polygons can be constructed by equal division of a circle	H3.2h	recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment; understand that the tangent at any point on a circle is perpendicular to the radius at that point; understand and use the fact that tangents from an external point are equal in length; explain why the perpendicular from the centre to a chord bisects the chord; understand that inscribed regular polygons can be constructed by equal division of a circle; use the facts that the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference, the angle subtended at the circumference by a semicircle is a right angle, that angles in the same segment are equal, and that opposite angles of a cyclic quadrilateral sum to 180 degrees
<b>3-D shapes</b>	F3.2j	explore the geometry of cuboids (including cubes), and shapes made from cuboids		
	F3.2k	use 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation	H3.2i	use 2-D representations of 3-D shapes and analyse 3-D shapes through 2-D projections and cross-sections, including plan and elevation; solve problems involving surface areas and volumes of prisms, cylinders






NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
H3.2e	understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles using formal arguments, and to verify standard ruler and compass constructions		
H3.2f	..... , including the use of Pythagoras' theorem in 3-D problems to calculate lengths in three dimensions		
H3.2g	..... then use these relationships in 3-D contexts, including finding the angles between a line and a plane (but not the angle between two planes or between two skew lines); calculate the area of a triangle using $\frac{1}{2}ab\sin C$ ; draw, sketch and describe the graphs of trigonometric functions for angles of any size, including transformations involving scalings in either or both the $x$ and $y$ directions; use the sine and cosine rules to solve 2-D and 3-D problems		
H3.2h	recall the meaning of the terms sector and segment; understand that the tangent at any point on a circle is perpendicular to the radius at that point; understand and use the fact that tangents from an external point are equal in length; explain why the perpendicular from the centre to a chord bisects the chord; prove and use the facts that the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference, the angle subtended at the circumference by a semicircle is a right angle, that angles in the same segment are equal, and that opposite angles of a cyclic quadrilateral sum to 180 degrees; prove and use the alternate segment theorem		
H3.2i	solve problems involving surface areas and volumes of prisms, pyramids, cylinders, cones and spheres; solve problems involving more complex shapes and solids, including segments of circles and frustrums of cones		










AO3 Shape, space and measures	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>3. Transformations and coordinates</b>				
<b>Specifying transformations</b>	F3.3a	understand that rotations are specified by a centre and an (anticlockwise) angle; rotate a shape about the origin; measure the angle of rotation using right angles, simple fractions of a turn; understand that reflections are specified by a mirror line, at first using line parallel to an axis, understand that translations are specified by a distance and direction, and enlargements by a centre and positive scale factor	H3.3a	understand that rotations are specified by a centre and an (anticlockwise) angle; use any point as the centre of rotation; measure the angle of rotation, using right angles, fractions of a turn or degrees; understand that reflections are specified by a (mirror) line; understand that translations are specified by giving a distance and direction (or a vector), and enlargements by a centre and a positive scale factor
<b>Properties of transformations</b>	F3.3b	recognise and visualise rotations, reflections and translations, including reflection symmetry of 2-D and 3-D shapes, and rotation symmetry of 2-D shapes; transform triangles and other 2-D shapes by translation, rotation and reflection, recognising that these transformations preserve length and angle, so that any figure is congruent to its image under any of these transformations	H3.3b	recognise and visualise rotations, reflections and translations including reflection symmetry of 2-D and 3-D shapes, and rotation symmetry of 2-D shapes; transform triangles and other 2-D shapes by translation, rotation and reflection and combinations of these transformations; distinguish properties that are preserved under particular transformations
	F3.3c	recognise, visualise and construct enlargements of objects using positive scale factors greater than one; understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not	H3.3c	recognise, visualise and construct enlargements of objects; understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not, then use positive fractional scale factors
	F3.3d	recognise that enlargements preserve angle but not length; identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments and apply this to triangles; understand the implications of enlargement for perimeter; use and interpret maps and scale drawings	H3.3d	recognise that enlargements preserve angle but not length; identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments; understand the implications of enlargement for perimeter; use and interpret maps and scale drawings; understand the difference between formulae for perimeter, area and volume by considering dimensions
<b>Coordinates</b>	F3.3e	understand that one coordinate identifies a point on a number line, two coordinates identify a point in a plane and three coordinates identify a point in space, using the terms '1-D', '2-D' and '3-D'; use axes and coordinates to specify points in all four quadrants; locate points with given coordinates; find the coordinates of points identified by geometrical information (1); find the coordinates of the midpoint of the line segment AB, given points A and B	H3.3e	..... then calculate the length AB
<b>Vectors</b>			H3.3f	understand and use vector notation;

NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>3. Transformations and coordinates</b>			
H3.3a	use any point as the centre of rotation; measure the angle of rotation, using fractions of a turn or degrees; understand that translations are specified by a vector		
H3.3b	transform triangles and other 2-D shapes by combinations of translation, rotation and reflection; use congruence to show that translations, rotations and reflections preserve length and angle, so that any figure is congruent to its image under any of these transformations; distinguish properties that are preserved under particular transformations		Intermediate/Higher : Pupils could use software to explore transformations and their effects on properties of shapes.
H3.3c	use positive fractional and negative scale factors (for enlargement)		
H3.3d	understand the difference between formulae for perimeter, area and volume by considering dimensions; understand and use the effect of enlargement on areas and volumes of shapes and solids		
H3.3e	calculate the length $AB$		Foundation : (1) [for example, find the coordinates of the fourth vertex of a parallelogram with vertices at (2, 1) (-7, 3) and (5, 6)
H3.3f	..... calculate, and represent graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector; calculate the resultant of two vectors; understand and use the commutative and associative properties of vector addition; solve simple geometrical problems in 2-D using vector methods		

AO3 Shape, space and measures	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>4. Measures and construction</b>				
<b>Measures</b>	F3.4a	interpret scales on a range of measuring instruments, including those for time and mass; convert measurements from one unit to another; know rough metric equivalents of pounds, feet, miles, pints and gallons; make sensible estimates of a range of measures in everyday settings	H3.4a	use angle measure (1); know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; understand and use compound measures, including speed and density
	F3.4b	understand angle measure using the associated language (1)		
	F3.4c	understand and use speed		
<b>Construction</b>	F3.4d	measure and draw lines to the nearest millimetre, and angles to the nearest degree; draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and angles; understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not; construct cubes, regular tetrahedra, square-based pyramids and other 3-D shapes from given information	H3.4b	draw approximate constructions of triangles and other 2-D shapes, using a ruler and protractor, given information about side lengths and angles; construct specified cubes, regular tetrahedra, square-based pyramids and other 3-D shapes
	F3.4e	use straight edge and compasses to do standard constructions including an equilateral triangle with a given side	H3.4c	....., the midpoint and perpendicular bisector of a line segment, the perpendicular from a point to a line, the perpendicular from a point on a line, and the bisector of an angle
<b>Mensuration</b>	F3.4f	find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach; recall and use the formulae for the area of a parallelogram and a triangle; find the surface area of simple shapes using the area formulae for triangles and rectangles; calculate perimeters and areas of shapes made from triangles and rectangles	H3.4d	find the surface area of simple shapes by using the formulae for the areas of triangles and rectangles; find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach; calculate volumes of right prisms and of shapes made from cubes and cuboids; convert between volume measures including $\text{cm}^3$ and $\text{m}^3$ ; find circumferences of circles and areas enclosed by circles, recalling relevant formulae
	F3.4g	find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach; calculate volumes of shapes made from cubes and cuboids		
	F3.4h	find circumferences of circles and areas enclosed by circles recalling relevant formulae		
	F3.4i	convert between area measures, including square centimetres and square metres, and volume measures, including cubic centimetres and cubic metres		
<b>Loci</b>			H3.4e	find loci, both by reasoning and by using ICT to produce shapes and paths (1)







NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>4. Measures and construction</b>			
H3.4a	know that measurements using real numbers depend on the choice of unit; recognise that measures given to the nearest whole unit may be inaccurate by up to one half in either direction; understand and use compound measures, including speed and density		Intermediate/Higher : (1) [for example, use bearings to specify direction]
			Foundation : (1) [for example, use bearings to specify direction]
H3.4c	.....		
H3.4d	find the surface area of simple shapes by using the formulae for the areas of triangles and rectangles; find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach; calculate volumes of right prisms; convert between volume measures including $\text{cm}^3$ and $\text{m}^3$ ; calculate the lengths of arcs and the areas of sectors of circles		N2.2
H3.4e	.....	 	Intermediate/Higher : (1) [for example, a region bounded by a circle and an intersecting line] IT1.2

AO4 Handling data	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>1. Using and applying handling data</b>				
<b>Problem solving</b>	F4.1a	carry out each of the four aspects of the handling data cycle to solve problems: (i) specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed (ii) collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources (iii) process and represent the data: turn the raw data into usable information that gives insight into the problem (iv) interpret and discuss the data: answer the initial question by drawing conclusions from the data	H4.1a	.....
	F4.1b	identify what further information is needed to pursue a particular line of enquiry	H4.1b	select the problem-solving strategies to use in statistical work, and monitor their effectiveness (these strategies should address the scale and manageability of the tasks, and should consider whether the mathematics and approach used are delivering the most appropriate solutions)
	F4.1c	select and organise the appropriate mathematics and resources to use for a task		
	F4.1d	review progress while working; check and evaluate solutions		
<b>Communicating</b>	F4.1e	interpret, discuss and synthesise information presented in a variety of forms	H4.1c	communicate mathematically, with emphasis on the use of an increasing range of diagrams and related explanatory text, on the selection of their mathematical presentation, explaining its purpose and approach, and on the use of symbols to convey statistical meaning
	F4.1f	communicate mathematically, including using ICT, making use of diagrams and related explanatory text		
<b>Reasoning</b>	F4.1h	apply mathematical reasoning, explaining inferences and deductions	H4.1d	apply mathematical reasoning, explaining and justifying inferences and deductions, justifying arguments and solutions
			H4.1e	identify exceptional or unexpected cases when solving statistical problems
	F4.1i	explore connections in mathematics and look for cause and effect when analysing data	H4.1f	explore connections in mathematics and look for relationships between variables when analysing data
			H4.1g	recognise the limitations of any assumptions and the effects that varying the assumptions could have on the conclusions drawn from data analysis

NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>1. Using and applying handling data</b>			
H4.1a	.....		N2.1, PS1.1, PS1.2, PS2.1, PS2.2, IT1.1, IT1.2, IT2.1
H4.1b	.....		PS1.2, PS1.3, PS2.2
			PS1.3, PS2.3
H4.1c	.....	 	Intermediate/Higher : Pupils could use databases or spreadsheets to present their findings and display their data. C1.3, N1.3, IT1.2, IT2.3
			IT1.2, IT2.3
H4.1d	.....		IT1.1
H4.1e	.....		All tiers : Promoting the skill of enquiry
H4.1f	.....		
H4.1g	.....		Intermediate/Higher Tiers : Promoting the skill of enquiry

AO4 Handling data	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>2. Specifying the problem and planning</b>				
	F4.2a	see that random processes are unpredictable	H4.2a	.....
	F4.2b	identify questions that can be addressed by statistical methods	H4.2b	identify key questions that can be addressed by statistical methods
	F4.2c	discuss how data relate to a problem	H4.2c	..... identify possible sources of bias and plan to minimise it
	F4.2d	identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals	H4.2d	.....
	F4.2e	design an experiment or survey; decide what secondary data to use	H4.2e	.....
<b>3. Collecting data</b>				
	F4.3a	design and use data-collection sheets for grouped discrete and continuous data; collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys	H4.3a	collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys
	F4.3b	gather data from secondary sources, including printed tables and lists from ICT-based sources	H4.3b	.....
	F4.3c	design and use two-way tables for discrete and grouped data	H4.3c	.....
			H4.3d	deal with practical problems such as non-response or missing data
<b>4. Processing and representing data</b>				
	F4.4a	draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs for time series, scatter graphs, frequency diagrams and stem-and-leaf diagrams	H4.4a	draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs (time series), scatter graphs, frequency diagrams, stem-and-leaf diagrams, cumulative frequency tables and diagrams and box plots
	F4.4b	calculate mean, range and median of small data sets with discrete then continuous data; identify the modal class for grouped data	H4.4e	find the median, quartiles and interquartile range for large data sets and calculate the mean for large data sets with grouped data
			H4.4f	calculate an appropriate moving average
	F4.4h	draw lines of best fit by eye, understanding what these represent	H4.4i	.....
			H4.4j	use relevant statistical functions on a calculator or spreadsheet
	F4.4c	understand and use the probability scale		
	F4.4d	understand and use estimates or measures of probability from theoretical models (including equally likely outcomes)	H4.4b	understand and use estimates or measures of probability from theoretical models, or from relative frequency
	F4.4e	list all outcomes for single events, and for two successive events, in a systematic way	H4.4c	.....
	F4.4f	identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1	H4.4d	.....
			H4.4h	use tree diagrams to represent outcomes of compound events, recognising when events are independent









NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>2. Specifying the problem and planning</b>			
H4.2c	identify possible sources of bias and plan to minimise it		C1.1, C1.2
H4.2d	select and justify a sampling scheme and a method to investigate a population, including random and stratified sampling		
H4.2e	decide what primary and secondary data to use		IT1.1, IT1.2, N1.1
<b>3. Collecting data</b>			
		 	IT1.1, IT2.1, N1.1
H4.3d	.....		
<b>4. Processing and representing data</b>			
H4.4a	draw and produce, using paper and ICT, cumulative frequency tables and diagrams, box plots and histograms for grouped continuous data		N1.3, N2.3, IT1.2, IT2.3
H4.4e	.....		N1.2, N2.2
H4.4f	.....		
H4.4i	.....		
H4.4j	.....		
H4.4b	.....		
H4.4g	know when to add or multiply two probabilities: if $A$ and $B$ are mutually exclusive, then the probability of $A$ or $B$ occurring is $P(A) + P(B)$ , whereas if $A$ and $B$ are independent events, the probability of $A$ and $B$ occurring is $P(A) \times P(B)$		
H4.4h	.....		

AO4 Handling data	NC ref	Foundation Tier	NC ref	Intermediate Tier
		pupils should be taught to:		pupils should be taught to:
<b>5. Interpreting and discussing results</b>				
	F4.5a	relate summarised data to the initial questions	H4.5a	.....
	F4.5b	interpret a wide range of graphs and diagrams and draw conclusions	H4.5b	interpret a wide range of graphs and diagrams and draw conclusions; identify seasonality and trends in time series
	F4.5c	look at data to find patterns and exceptions	H4.5c	.....
	F4.5d	compare distributions and make inferences, using the shapes of distributions and measures of average and range	H4.5d	compare distributions and make inferences, using shapes of distributions and measures of average and spread, including median and quartiles
	F4.5e	consider and check results and modify their approach if necessary	H4.5e	.....
	F4.5f	have a basic understanding of correlation as a measure of the strength of the association between two variables; identify correlation or no correlation using lines of best fit	H4.5f	appreciate that correlation is a measure of the strength of the association between two variables; distinguish between positive, negative and zero correlation using lines of best fit; appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'
	F4.5g	use the vocabulary of probability to interpret results involving uncertainty and prediction	H4.5g	..... (1)
	F4.5h	compare experimental data and theoretical probabilities	H4.5h	.....
	F4.5i	understand that if they repeat an experiment, they may – and usually will – get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics	H4.5i	.....
	F4.5j	discuss implications of findings in the context of the problem		
	F4.5k	interpret social statistics including index numbers (1); time series (2); and survey data (3)		

### Breadth of Study (Foundation)

During the key stage, pupils should be taught the Knowledge, skills and understanding through:

- a) extending mental and written calculation strategies and using efficient procedures confidently to calculate with integers, fractions, decimals, percentages, ratio and proportion
- b) solving a range of familiar and unfamiliar problems, including those drawn from real-life contexts and other areas of the curriculum
- c) activities that provide frequent opportunities to discuss their work, to develop reasoning and understanding and to explain their reasoning and strategies
- d) activities focused on developing short chains of deductive reasoning and correct use of the '=' sign
- e) activities in which they do practical work with geometrical objects, visualise them and work with them mentally
- f) practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data
- g) activities focused on the major ideas of statistics, including using appropriate populations and representative samples, using different measurement scales, using probability as a measure of uncertainty, using randomness and variability, reducing bias in sampling and measuring, and using inference to make decisions
- h) substantial use of tasks focused on using appropriate ICT [for example, spreadsheets, databases, geometry or graphic packages], using calculators correctly and efficiently, and knowing when not to use a calculator.

NC ref	Higher Tier		Key Skills and notes
	pupils should be taught to:		
<b>5. Interpreting and discussing results</b>			
H4.5b	identify seasonality and trends in time series	 	N1.3, N2.3
			Foundation/ Intermediate : Pupils could use databases to present their findings.
H4.5d	compare distributions and make inferences, using shapes of distributions and measures of average and spread, including median and quartiles; understand frequency density		N1.3, N2.3
			PS1.3
H4.5f	.....		
			Intermediate : (1) [for example, 'here is some evidence from this sample that ...']
			IT1.1
			Foundation : (1) [for example, the General Index of Retail Prices]; (2) [for example, population growth]; (3) [for example, the National Census]

### Breadth of Study (Intermediate and Higher)

During the key stage, pupils should be taught the Knowledge, skills and understanding through:

- activities that ensure they become familiar with and confident using standard procedures for the range of calculations appropriate to this level of study
- solving familiar and unfamiliar problems in a range of numerical, algebraic and graphical contexts and in open-ended and closed form
- using standard notations for decimals, fractions, percentages, ratio and indices
- activities that show how algebra, as an extension of number using symbols, gives precise form to mathematical relationships and calculations
- activities in which they progress from using definitions and short chains of reasoning to understanding and formulating proofs in algebra and geometry
- a sequence of practical activities that address increasingly demanding statistical problems in which they draw inferences from data and consider the uses of statistics in society
- choosing appropriate ICT tools and using these to solve numerical and graphical problems, to represent and manipulate geometrical configurations and to present and analyse data.