

Content Mapping

GCSE Applications of Mathematics **GCSE Methods in Mathematics**

OCR GCSE in Applications of Mathematics: J925

OCR GCSE in Methods in Mathematics: J926

This mapping document is designed to accompany the OCR GCSE Applications of Mathematics specification J925 and the OCR GCSE Methods in Mathematics specification J926 (for teaching from September 2010), for teachers currently using GCSE Mathematics C (J517) – Graduated Assessment.

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Introduction – Linked pair Mathematics

This document is designed to assist teachers using the current Mathematics C (Graduated Assessment) J517 specification in making the transition to the pilot Applications of Mathematics specification J925, and the pilot Methods in Mathematics specification J926 for first teaching from September 2010. The purpose of the document is to help teachers see how the content of the ten Graduated Assessment modules fits into the four units of the pilot specification. Additionally, it allows teachers to see how the content of the three units in the new Specification A J562 relate to the content of the pilot specification.

Content references from the modules within the Graduated Assessment J517 specification are listed on a 'best-fit' basis against the content statements for the pilot Applications of Mathematics and Methods in Mathematics specifications and also the new Mathematics A specification. These references are written in the two columns on the right-hand side of the table. One column is for Specification A J562 and the other for the current Graduated Assessment J517 specification.

How to use this document – an example

- The Applications of Mathematics content statement F1J 1b (on page 8 of this document) is “manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket and by taking out common factors.” The F1J element indicates Foundation paper 1, section J (Linear equations) and 1b indicates item 1 element b. The identical statement appears in the Methods in Mathematics specification also as content statement F1J 1b (on page 37 of this document).
- There is no single statement within Graduated Assessment J517 that matches this statement but the “best-fit” Foundation tier reference for Graduated Assessment is A6.1 “manipulate algebraic expressions by multiplying a single term over a bracket and by taking out single term common factors.” The collecting like terms demand is contained in Graduated Assessment statement A5.3 “manipulate algebraic expressions by collecting like terms.” and therefore both A5.3 and A6.1 are referenced, in the far right hand column, against the F1J 1b statement in Applications of Mathematics and against the F1J 1b statement in Methods in Mathematics.

Applications of Mathematics

Foundation tier A381/01		Spec A J562 ref	Spec J517 ref
F1A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	FA1.1, FB1.1, FC1.1	
	b. 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;	FA1.1, FB1.1, FC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	FA1.1, FB1.1, FC1.1	
	d. use notation and symbols correctly and consistently within a problem;	FA1.1, FB1.1, FC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	FA1.1, FB1.1, FC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	FA1.1, FB1.1, FC1.1	
	g. present and interpret solutions in the context of the original problem;	FA1.1, FB1.1, FC1.1	
	h. review and justify their choice of mathematical presentation;	FA1.1, FB1.1, FC1.1	
	i. identify exceptional cases when solving problems;	FA1.1, FB1.1, FC1.1	
	j. show deduction in solving a problem;	FA1.1, FB1.1, FC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	FA1.1, FB1.1, FC1.1	

F1B Number			
1. Add, subtract, multiply and divide any number	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	FA2.1, FC2.1	N1.4, N2.1, N2.4, N4.1, N5.6
	b. add, subtract, multiply and divide integers and then any number;	FA2.1	
	c. multiply or divide any number by powers of 10;	FA2.1	
	d. multiply or divide any positive number by a number between 0 and 1;	FA2.1	
	e. multiply and divide by a negative number;	FA2.1	
	f. recall all positive integer complements to 100;	FB2.1, FC2.1	
	g. recall all multiplication facts to 10×10 , and use them to derive quickly the corresponding division facts;	FB2.1, FC2.1	
	h. develop a range of strategies for mental calculation; derive unknown facts from those they know;	FB2.1	
	i. add and subtract mentally numbers with up to two decimal places;	FB2.1	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	FB2.1	
	k. add and subtract integers and decimals understanding where to position the decimal point;	FB2.1	
l. perform a calculation involving division by a decimal (up to two decimal places).	FB2.1		
2. Approximate to a specified or appropriate degree of accuracy	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	FA2.2	N1.1, N5.1
	b. estimate answers to problems involving decimals;	FB2.2	
	c. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	FB2.2	
	d. round to the nearest integer, to any number of decimal places, specified of appropriate, and to any number of significant figures;	FA2.2, FB2.2, FC2.2	
	e. 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;	FC2.2	
	f. 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.	FC2.2	

3. Use calculators effectively and efficiently	a. use calculators effectively and efficiently;	FA2.3, FC2.3	N6.1
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers;	FA2.3, FC2.3	
	c. enter a range of calculations, including those involving measures and statistics.	FA2.3, FC2.3	
F1C Hierarchy of operations			
1. Hierarchy of operations	a. use brackets and the hierarchy of operations.	FA3.1	F3.7, F6.5
F1D Factors, multiples and primes			
1. Factors, multiples and primes	a. use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple and prime number.	FA5.1	N1.2, N4.4, N7.7
F1E Fractions, decimals and percentages			
1. Calculate with fractions	a. calculate a given fraction of a given quantity, expressing the answer as a fraction;	FB3.1, FC2.1	N1.5, N2.6, N3.4, N5.3, N5.5, N6.3, N6.4, N7.7, N8.4
	b. express a given number as a fraction of another;	FB3.1, FC2.1	
	c. add and subtract fractions by writing them with a common denominator;	FB3.1, FC2.1	
	d. convert a simple fraction to a decimal;	FB3.1, FC2.1	
	e. multiply and divide a fraction by an integer and by a unit fraction;	FB3.1, FC2.1	
	f. understand and use unit fractions as multiplicative inverses.	FB3.1, FC2.1	
2. Order rational numbers	a. order integers;	FB3.2	N1.1, N4.2, N6.4
	b. order fractions;	FB3.2	
	c. order decimals.	FB3.2	
3. Understand equivalent fractions	a. understand equivalent fractions and simplify a fraction.	FB3.3	N5.3
4. Understand percentage	a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions;	FB3.5	N2.5, N5.4, N7.6
	b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	FB3.5	

5. Interpret fractions, decimals and percentages as operators	a. interpret percentage as the operator 'so many hundredths of';	FB3.6	N2.5, N5.4, N7.6
	b. convert simple fractions of a whole to percentages of the whole, and vice versa;	FB3.6	
	c. understand the multiplicative nature of percentages as operators.	FB3.6	
6. Proportional change.	a. find proportional change using fractions, decimals and percentages;	FC4.3	N7.5
	b. understand and use direct proportion.	FC4.3	
F1F Indices and surds			
1. Common index numbers	a. use the terms 'square', 'positive square root', 'negative square root', 'cube' and 'cube root';	FB4.1	N3.1, N5.2, N7.2
	b. recall integer squares from 11×11 to 15×15 and the corresponding square roots;	FB4.1	
	c. recall the cubes of 2, 3, 4, 5 and 10.	FB4.1	
2. Use index notation	a. use index notation for squares, cubes and powers of 10;	FB4.2	N3.1, N5.2, N7.2
	b. use index notation for simple positive integer powers;	FB4.2	
	c. use index laws for multiplication and division of integer powers.	FB4.2	
F1G Measures			
1. Solve real life problems involving measures	a. interpret scales on a range of measuring instruments, and recognise the inaccuracy of measurements;	FA9.1, FB8.1, FC8.1	N1.6, N3.6, S1.1, S1.2, S1.7, S2.1, S2.2, S2.3, S2.6, S3.1, S3.2, S3.4, S4.1, S5.2, S7.1, S7.5, S7.8
	b. convert measurements from one unit to another;	FA9.1, FB8.1, FC8.1	
	c. make sensible estimates of a range of measures in everyday settings;	FA9.1	
	d. understand and use compound measures (including speed and density) in familiar contexts;	FC4.4, FC8.1	
	e. understand and use bearings;	FA11.1	
	f. measure and draw lines and angles.		

F1H Coordinates			
1. Use the conventions for coordinates in the plane	a. use the conventions for coordinates in the plane; plot points in all four quadrants;	FA6.3, FB5.3, FC5.3	A1.3, S4.4, S7.6
	b. understand that one coordinate identifies a point on a number line and two coordinates identify a point in a plane, using the terms '1D' and '2D';	FA6.3, FB5.3, FC5.3	
	c. use axes and coordinates to specify points in all four quadrants;	FA6.3, FB5.3, FC5.3	
F1I Formulae			
1. Derive a formula, substitute numbers into a formula	a. use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols;	FA7.1	A2.2, A3.2, A4.1, A5.1, A6.3, A7.1, A7.3
	b. substitute numbers into a formula;	FA7.1	
	c. derive a formula.	FA7.1	
F1 J Linear equations			
1. Manipulate algebraic expressions	a. understand that the transformation of algebraic expressions obeys and generalises the rules of generalised arithmetic;	FA8.1, FC6.1	A5.3, A6.1
	b. manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors.	FA8.1, FC6.1	
2. Set up and solve simple equations and inequalities	a. set up simple equations;	FA8.2	A1.2, A3.1, A5.2, A6.2, A7.2
	b. solve simple equations by using inverse operations or by transforming both sides in the same way;	FA8.2	
	c. solve simple linear inequalities in one variable and represent the solution on a number line.	FA8.2	
3. Plot graphs of simple equations	recognise and plot equations that correspond to straight-line graphs in the coordinate plane.	FA6.3	A1.3, S4.4, S7.6

F1K Angles and properties of shapes			
1. Lines and angles	a. 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;	FB9.1	S2.1, S2.3, S4.2, S6.1, S7.2
	b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees;	FB9.1	
	c. distinguish between lines and line segments;	FB9.1	
	d. use parallel lines, alternate angles and corresponding angles;	FB9.1	
	e. understand the consequent properties of parallelograms.	FB9.1	
2. Properties of shapes	a. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus;	FB9.2	S1.5, S4.2, S5.3, S6.1, S6.2, S6.3
	b. classify quadrilaterals by their geometric properties;	FB9.2	
	c. distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment;	FB9.2	
	d. understand that inscribed regular polygons can be constructed by equal division of a circle;	FB9.2	
	e. recognise reflection and rotation symmetry of 2D shapes.	FB9.2	
3. Congruence and similarity	a. understand congruence;	FB10.1	S6.8, S8.3
	b. understand similarity and the relationship between lengths in similar figures.	FB10.1	
F1L Area and Volume			
	a. find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach;	FC9.1	
	b. find the area of a parallelogram and a triangle;	FC9.1	
	c. calculate perimeters and areas of shapes made from triangles and rectangles.	FC9.1	

Foundation tier A382/01		Spec A J562 ref	Spec J517 ref
F2A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	FA1.1, FB1.1, FC1.1	
	b. 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;	FA1.1, FB1.1, FC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	FA1.1, FB1.1, FC1.1	
	d. use notation and symbols correctly and consistently within a problem;	FA1.1, FB1.1, FC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	FA1.1, FB1.1, FC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	FA1.1, FB1.1, FC1.1	
	g. present and interpret solutions in the context of the original problem;	FA1.1, FB1.1, FC1.1	
	h. review and justify their choice of mathematical presentation;	FA1.1, FB1.1, FC1.1	
	i. identify exceptional cases when solving problems;	FA1.1, FB1.1, FC1.1	
	j. show deduction in solving a problem;	FA1.1, FB1.1, FC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	FA1.1, FB1.1, FC1.1	

F2B Number			
1. Add, subtract, multiply and divide any number	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	FA2.1, FC2.1	N1.3, N1.4, N2.1, N2.2, N2.3, N2.4, N4.1, N4.3, N5.6, N6.3, N7.1
	b. add, subtract, multiply and divide integers and then any number;	FA2.1	
	c. multiply or divide any number by powers of 10;	FA2.1	
	d. multiply or divide any positive number by a number between 0 and 1;	FA2.1	
	e. multiply and divide by a negative number;	FA2.1	
	f. recall all positive integer complements to 100;	FB21	
	g. recall all multiplication facts to 10×10 , and use them to derive quickly the corresponding division facts;	FB2.1, FC2.1	
	h. develop a range of strategies for mental calculation; derive unknown facts from those they know;	FB2.1, FC2.1	
	i. add and subtract mentally numbers with up to two decimal places;	FB2.1	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	FB2.1	
	k. add and subtract integers and decimals understanding where to position the decimal point;	FB2.1	
l. perform a calculation involving division by a decimal (up to two decimal places) by transforming it to a calculation involving division by an integer.	FB2.1		
2. Use calculators effectively and efficiently	a. use calculators effectively and efficiently;	FA2.3, FC2.3	N6.1
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers;	FA2.3, FC2.3	
	c. enter a range of calculations, including those involving statistics.	FA2.3, FC2.3	
F2C Hierarchy of operations			
1. Hierarchy of operations	a. understand and use number operations and the relationships between them, including inverse operations.	FA3.1	F3.7, F6.5

F2D Ratio			
1. Divide a quantity in a given ratio	a. divide a quantity in a given ratio;	FA4.2	N4.5, N6.2, N7.4
	b. determine the original quantity by knowing the size of one part of the divided quantity;	FA4.2	
	c. solve word problems about ratio, including using informal strategies and the unitary method of solution.	FA4.2	
F2E Financial applications			
1. Financial and business applications	a. carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation;		
	b. use mathematics in the context of personal and domestic finance including loan repayments, budgeting, exchange rates and commissions;		
	c. use spreadsheets to model financial and other numerical situations;		
	d. construct and use flowcharts.		
F2F Coordinates			
1. Use the conventions for coordinates in the plane	a. given the coordinates of points A and B, find the coordinates of the midpoint of the line segment AB;	FA6.3	A1.3, S4.4, S7.6
	b. given the coordinates of points A and B, calculate the length AB.	FA6.3	
F2G Linear inequalities			
1. Set up and solve simple inequalities	a. set up linear inequalities in one variable;	FB7.1	A7.6
	b. solve simple inequalities by transforming both sides in the same way;	FB7.1	
	c. solve simple linear inequalities in one variable and represent the solution on a number line.	FB7.1	
F2H Functions and graphs			
1. Functions from real life	a. find and interpret gradients and intercepts of straight line graphs in practical contexts;	FB6.1	A3.3, A4.3, A6.4, A6.5
	b. construct linear functions from real life problems and plot their corresponding graphs;	FC7.1	
	c. discuss, plot and interpret graphs (which may be non-linear) modelling real situations, including journeys/travel graphs;	FC7.1	
	d. recognise and use graphs that illustrate direct proportion.	HC5.3	

F2L Algebraic manipulation			
1. Use trial and improvement to solve equations	a. find approximate solutions of equations using graphical method and systematic trial and improvement.	FC6.2	N4.6, A7.7
F2J Estimate areas			
Estimate areas	a. estimate areas of irregular shapes;		
	b. estimate areas bounded by straight lines.		
F2K Pythagoras in 2D			
1. Use Pythagoras' theorem	a. understand, recall and use Pythagoras' theorem to solve simple cases in 2D.	FA12.1	S7.3
F2L Area and Volume			
1. Perimeter, area (including circles), and volume	a. find circumferences of circles and areas enclosed by circles, recalling relevant formulae;	FC9.1	S6.4, S7.4, S7.5
	b. find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach;	FC9.1	
	c. calculate volumes of right prisms and of shapes made from cubes and cuboids.	FC9.1	
2. Use 2D representations of 3D shapes	a. explore the geometry of cuboids (including cubes) and objects made from cuboids;	FC9.2	S2.4, S3.3, S5.4, S6.2, S6.3, S6.6
	b. use 2D representations of 3D objects; analyse 3D objects through 2D projections (including plan and elevation) and cross-sections;	FC9.2	
	c. draw nets of 3D objects;	FC9.2	
	d. construct nets of cubes, regular tetrahedra, square-based pyramids and other 3D shapes from given information.	FC9.2	

F2M Constructions			
1. Draw triangles and other 2-D shapes using a ruler and protractor	a. draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and angles.	FA10.1	S1.3, S1.5, S2.3, S5.1, S6.3
2. Use straight edge and a pair of compasses to do constructions	a. use straight edge and compasses to do standard constructions, including;		
	i. an equilateral triangle with a given side,	FA10.2	S7.7
	ii. the midpoint and perpendicular bisector of a line segment,	FA10.2	
	iii. the perpendicular from a point to a line, the perpendicular from a point on line,	FA10.2	
	iv. the bisector of an angle.	FA10.2	
3. Construct loci	a. find loci, by reasoning to produce shapes and paths.	FA10.3	S7.7
F2N Maps			
1. Maps and scale drawings	a. use and interpret maps and scale drawings.	FA11.1	S1.7, S2.6, S3.4, S5.2

F20 Statistics and Probability			
1. Understand and use statistical problem solving process/handling data cycle	a. 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;	FA13.1	
	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.		
2. Experimenting	a. understand that when a statistical experiment or survey is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics.	FA13.4	
3. Collecting	a. design an experiment or survey, identifying possible sources of bias;	FA13.2	
	b. design data-collection sheets distinguishing between different types of data;	FA13.2	
	c. extract data from publications, charts, tables and lists;	FA13.2	
	d. design, use and interpret two-way tables for discrete and grouped data.	FA13.2	
4. Processing	a. draw and interpret charts and diagrams for categorical data including bar charts, pie charts and pictograms;	FA13.3	D1.3, D2.2, D3.2, D3.3, D4.2, D5.2, D5.3, D6.3, D7.2
	b. produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem and leaf diagrams;	FA13.3	
	c. calculate median; mean, range, mode and modal class;	FA13.3	
	d. find the median for large, ungrouped, data sets.	FA13.3	

5. Interpreting	a. look at data to find patterns and exceptions;	FA13.4	D1.3, D3.3, D4.2, D4.3, D5.2, D5.3, D6.3
	b. interpret a wide range of graphs and diagrams and draw conclusions;	FA13.4	
	c. interpret social statistics including index numbers; and survey data;	FA13.4	
	d. compare distributions and make inferences;	FA13.4	
	e. using the shapes of distributions and measures of average and range.	FA13.4	
6. Use charts and correlation	a. draw and interpret scatter graphs;	FB11.1	D4.3, D6.2, D7.3
	b. recognise correlation and draw and/or use lines of best fit by eye, understanding and interpreting what these represent, and appreciating that correlation does not imply causality;	FB11.1	
	c. work with time series including their graphical representation.	FB11.1	
7. Probability and risk	a. understand and use the vocabulary of probability and the probability scale;	FC10.1	D1.1, D1.2, D2.1, D3.1, D4.1, D5.1, D6.1, D7.1
	b. understand and use theoretical models for probabilities including the model of equally likely outcomes;	FC10.1	
	c. understand and use estimates of probability from relative frequency;	FC10.1	
	d. use probability to estimate risk and make a decision about a course of action.		

Higher tier A381/02		Spec A J562 ref	Spec J517 ref
H1A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	HA1.1, HB1.1, HC1.1	
	b. 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;	HA1.1, HB1.1, HC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	HA1.1, HB1.1, HC1.1	
	d. use notation and symbols correctly and consistently within a problem;	HA1.1, HB1.1, HC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	HA1.1, HB1.1, HC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	HA1.1, HB1.1, HC1.1	
	g. present and interpret solutions in the context of the original problem;	HA1.1, HB1.1, HC1.1	
	h. review and justify their choice of mathematical presentation;	HA1.1, HB1.1, HC1.1	
	i. identify exceptional cases when solving problems;	HA1.1, HB1.1, HC1.1	
	j. show deduction in solving a problem;	HA1.1, HB1.1, HC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	HA1.1, HB1.1, HC1.1	

H1B Number			
1. Add, subtract, multiply and divide any number	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	HA2.1	N1.3, N1.4, N2.1, N2.2, N2.3, N2.4, N3.2, N3.3, N4.1, N4.3, N5.6, N6.3, N7.1
	b. add, subtract, multiply and divide integers and then any number;	HA2.1	
	c. multiply or divide any number by powers of 10;	HA2.1	
	d. multiply or divide any positive number by a number between 0 and 1;	HA2.1	
	e. multiply and divide by a negative number;	HA2.1	
	f. recall all positive integer complements to 100;	HB2.1	
	g. recall all multiplication facts to 10×10 , and use them to derive quickly the corresponding division facts;	HB2.1	
	h. derive unknown facts from those they know;	HB2.1	
	i. add and subtract mentally numbers with up to two decimal places;	HB2.1	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	HB2.1	
	k. add and subtract integers and decimals understanding where to position the decimal point;	HB2.1	
l. perform a calculation involving division by a decimal (up to two decimal places).	HB2.1		
2. Approximate to a specified or appropriate degree of accuracy	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	HA2.2, HB2.2	N1.1, N5.1, N7.3, N9.2
	b. estimate answers to problems involving decimals;	HB2.2	
	c. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	HB2.2	
	d. round to the nearest integer, to any number of decimal places, specified of appropriate, and to any number of significant figures;	HB2.2. HC2.2	
	e. 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;	HB2.2. HC2.2	
	f. 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.	HB2.2. HC2.2	

3. Use calculators effectively and efficiently	a. use calculators effectively and efficiently;	HA2.3, HC2.3	N6.1
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers;	HA2.3, HC2.3	
	c. enter a range of calculations, including those involving measures and statistics;	HA2.3, HC2.3	
	d. Use an extended range of function keys, including trigonometrical functions.	HA2.3, HC2.3	
H1C Hierarchy of operations			
1. Hierarchy of operations	a. use brackets and the hierarchy of operations.	HA3.1	F3.7, F6.5
H1D Factors, multiples and primes			
1. Factors, multiples and primes	a. use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple and prime number.	HA5.1	N1.2, N4.4, N7.7
H1E Fractions, decimals and percentages			
1. Calculate with fractions	a. calculate a given fraction of a given quantity, expressing the answer as a fraction;	HB3.1, HC2.1	N1.5, N2.6, N3.4, N5.3, N5.5, N6.3, N6.4, N7.7, N8.4
	b. express a given number as a fraction of another;	HB3.1, HC2.1	
	c. add and subtract fractions by writing them with a common denominator;	HB3.1, HC2.1	
	d. convert a simple fraction to a decimal;	HB3.1, HC2.1	
	e. multiply and divide a fraction by an integer and by a unit fraction;	HB3.1, HC2.1	
	f. understand and use unit fractions as multiplicative inverses.	HB3.1, HC2.1	
2. Order rational numbers	a. order integers;	HB3.2	N1.1, N4.2, N6.4
	b. order fractions;	HB3.2	
	c. order decimals.	HB3.2	
3. Understand equivalent fractions	a. understand equivalent fractions and simplify a fraction.	HB3.3	N5.3
4. Understand percentage	a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions;	HB3.5	N2.5, N5.4, N7.6
	b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	HB3.5	

5. Interpret fractions, decimals and percentages as operators	a. interpret percentage as the operator 'so many hundredths of';	HB3.6	N2.5, N5.4, N5.5, N7.6, N8.1, N8.2
	b. convert between fractions, decimals and percentages;	HB3.6	
	c. understand the multiplicative nature of percentages as operators;	HB3.6	
	d. understand and use repeated percentage change;	HC5.2	
	e. solve reverse percentage problems.	HC2.3	
6. Proportional change	a. find proportional change using fractions, decimals and percentages;	HC5.3	N4.5, N6.2, N7.5, N8.2
	b. understand and use direct proportion;	HC5.3	
	c. use repeated proportional change.	HC1.1	
H1F Indices and surds			
1. Indices in common use	a. use the terms 'square', 'positive square root', 'negative square root', 'cube' and 'cube root';	HB4.1	N3.1, N5.2, N7.2
	b. recall integer squares from 11×11 to 15×15 and the corresponding square roots;	HB4.1	
	c. recall the cubes of 2, 3, 4, 5 and 10.	HB4.1	
2. Use index notation	a. use index notation for squares, cubes and powers of 10;	HB4.2	N3.1, N5.2, N7.2, N9.3
	b. use index notation for simple positive integer powers;	HB4.2	
	c. use index laws for multiplication and division of integer powers;	HB4.2	
	d. know that $n^0 = 1$; understand that the inverse operation of raising a positive number to power n is raising the result of this operation to power $1/n$;	HB4.2	
	e. know that $n^{-1} = 1/n$ (undefined for $n = 0$), and that $n^{1/2} = \sqrt{n}$ and $n^{1/3} = \sqrt[3]{n}$ for any positive number n ;	HB4.2	
	f. simplify, and calculate the value of, numerical expressions involving multiplication and division of integer, fractional and negative powers.	HB4.2	

H1G Measures			
1. Solve real life problems involving measures	a. interpret scales on a range of measuring instruments, and recognise the inaccuracy of measurements;	HA9.1	S1.1, S1.2, S1.7, S2.1, S2.2, S2.6, S3.1, S3.3, S3.4, S4.1, S5.2, S8.3
	b. convert measurements from one unit to another;	HA9.1	
	c. make sensible estimates of a range of measures in everyday settings;	HA9.1	
	d. understand and use compound measures (including speed ⁽²⁾ and density) in familiar contexts;	HC9.1	
	e. understand and use bearings.	HA11.1, HA12.1	
H1H Coordinates			
1. Use the conventions for coordinates in the plane	a. use the conventions for coordinates in the plane; plot points in all four quadrants;	HA6.3, HB5.3, HC6.3	A1.3, S4.4, S7.6, S9.2
	b. 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 '1D', '2D' and '3D';	HA6.3, HB5.3, HC6.3	
	c. use axes and coordinates to specify points in all four quadrants;	HA6.3, HB5.3, HC6.3	
	d. locate points with given coordinates.	HA6.3, HB5.3, HC6.3	
H1I Formulae			
1. Derive a formula, substitute numbers into a formula	a. use formulae from mathematics and other subjects expressed initially in words and then using letters and symbols;	HA7.1	A2.2, A3.2, A4.1, A5.1, A6.3, A7.1, A7.3
	b. substitute numbers into a formula;	HA7.1	
	c. derive a formula.	HA7.1	
H1J Linear equations			
1. Manipulate algebraic expressions	a. understand that the transformation of algebraic expressions obeys and generalises the rules of generalised arithmetic;	HA8.1, HC7.1	A1.2, A5.2, A5.3, A6.1, A7.4, A8.2, A9.3, A10.1
	b. manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors;	HA8.1, HC7.1	

2. Set up and solve simple equations	a. set up simple equations;	HA8.2	A3.1, A5.2, A6.2, A7.2, A8.2, A9.3, A10.1
	b. solve simple equations by using inverse operations or by transforming both sides in the same way;	HA8.2	
	c. solve linear equations in which the unknown appears on either side or on both sides of the equation.	HA8.2	
3. Plot graphs of simple equations	a. recognise and plot equations that correspond to straight-line graphs in the coordinate plane.	HB6.3	A5.4, A6.4, A8.7
4. Simultaneous equations in two unknowns	a. set up and solve, linear simultaneous equations in two unknowns.	HB6.2	A8.4
H1K Angles and properties of shapes			
1. Lines and angles	a. 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;	HB9.1	S2.1, S2.3, S4.2, S6.1, S7.2
	b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees;	HB9.1	
	c. distinguish between lines and line segments;	HB9.1	
	d. use parallel lines, alternate angles and corresponding angles;	HB9.1	
	e. understand the consequent properties of parallel and intersecting lines, triangles (including a proof that the angle sum of a triangle is 180°) and parallelograms.	HB9.1	
2. Properties of shapes	a. use angle properties of equilateral, isosceles and right-angled triangles;	HB9.2	S1.5, S4.2, S5.3, S6.1, S6.2, S6.3
	b. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus;	HB9.2	
	c. classify quadrilaterals by their geometric properties;	HB9.2	
	d. distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment;	HB9.2	
	e. understand that inscribed regular polygons can be constructed by equal division of a circle;	HB9.2	
	f. recognise reflection and rotation symmetry of 2-D shapes.		
3. Congruence and similarity	a. understand congruence;	HB10.1	S6.8, S8.4
	b. understand similarity and the relationship between lengths in similar figures.	HB10.1	

H1L Area and Volume			
1. Perimeter, area and volume	a. find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach;	HC10.1	S1.3, S1.4, S4.3, S5.4, S6.4, S6.5, S7.4, S7.5, S9.3, S10.1
	b. find the area of a parallelogram and a triangle;	HC10.1	
	c. calculate perimeters and areas of shapes made from triangles and rectangles.	HC10.1	

Higher tier A382/02		Spec A J562 ref	Spec J517 ref
H2A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	HA1.1, HB1.1, HC1.1	
	b. 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;	HA1.1, HB1.1, HC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	HA1.1, HB1.1, HC1.1	
	d. use notation and symbols correctly and consistently within a problem;	HA1.1, HB1.1, HC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	HA1.1, HB1.1, HC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	HA1.1, HB1.1, HC1.1	
	g. present and interpret solutions in the context of the original problem;	HA1.1, HB1.1, HC1.1	
	h. review and justify their choice of mathematical presentation;	HA1.1, HB1.1, HC1.1	
	i. identify exceptional cases when solving problems;	HA1.1, HB1.1, HC1.1	
	j. show deduction in solving a problem;	HA1.1, HB1.1, HC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	HA1.1, HB1.1, HC1.1	

H2B Number			
1. Add, subtract, multiply and divide any number	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	HA2.1	N1.4, N2.1, N2.4, N4.1, N5.6
	b. add, subtract, multiply and divide integers and then any number;	HA2.1	
	c. multiply or divide any number by powers of 10;	HA2.1	
	d. multiply or divide any positive number by a number between 0 and 1;	HA2.1	
	e. multiply and divide by a negative number;	HA2.1	
	f. recall all positive integer complements to 100;	HB2.1, HC2.1	
	g. recall all multiplication facts to 10×10 , and use them to derive quickly the corresponding division facts;	HB2.1, HC2.1	
	h. derive unknown facts from those they know;	HB2.1	
	i. add and subtract numbers with up to two decimal places;	HB2.1	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	HB2.1	
	k. add and subtract integers and decimals understanding where to position the decimal point;	HB2.1	
l. perform a calculation involving division by a decimal (up to two decimal places) by transforming it to a calculation involving division by an integer.	HB2.1		
2. Use calculators effectively and efficiently	a. use calculators effectively and efficiently;	HA2.3	N6.1
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers;	HA2.3	
	c. enter a range of calculations, including those involving measures and statistics;	HA2.3	
	d. use an extended range of function keys, including trigonometrical and statistical functions.	HA2.3	
H2C Use upper and lower bounds			
Understand and use upper and lower bounds	a. use calculators, or written methods, to calculate the upper and lower bounds of calculations.	HC4.1	S7.1, S9.1

H2D Hierarchy of operations			
1. Hierarchy of operations	a. understand and use number operations and the relationships between them, including inverse operations.	HA3.1	F3.7, F6.5
H2E Ratio			
1. Divide a quantity in a given ratio	a. divide a quantity in a given ratio;		
	b. determine the original quantity by knowing the size of one part of the divided quantity;	HA4.2	N4.5, N6.2, N7.4
	c. solve word problems about ratio, including using informal strategies and the unitary method of solution.	HA4.2	
H2F Indices and surds			
1. Exponential growth and decay	a. understand exponential growth and decay, its relationship with repeated proportional change and financial and scientific applications.	HC5.5	N10.1
H2G Standard index form			
Standard index form	a. use and express standard index form expressed in conventional notation and on a calculator display;	HC3.1	N8.3, N9.2
	b. calculate with standard index form;	HC3.1	
	c. convert between ordinary and standard index form representations, converting to standard index form to make sensible estimates for calculations involving multiplication and/or division.	HC3.1	
H2H Financial applications			
1. Financial and business applications	a. carry out calculations relating to enterprise, saving and borrowing, appreciation and depreciation;		
	b. use mathematics in the context of personal and domestic finance including loan repayments, budgeting, exchange rates and commissions;		
	c. use spreadsheets to model financial and other numerical situations;		
	d. construct and use flowcharts;		
	e. understand AER (annual equivalent rate), RPI (retail prices index) and CPI (consumer price index).		
H2I Coordinates			
1. Use the conventions for coordinates in the plane	a. given the coordinates of points A and B, find the coordinates of the midpoint of the line segment AB;	HA6.3	A1.3, S4.4, S7.6, S9.2
	b. given the coordinates of points A and B, calculate the length AB.	HA6.3	

H2J Linear inequalities			
1. Set up and solve simple inequalities	a. set up linear inequalities in one variable;	HB7.1	A7.6, A8.6
	b. solve simple inequalities by transforming both sides in the same way;	HB7.1	
	c. solve simple linear inequalities in one variable and represent the solution on a number line.	HB7.1	
H2K Linear programming			
1. Set up and solve problems in linear programming	a. set up and solve problems in linear programming, finding optimal solutions.		
H2L Functions and graphs			
1. Functions from real life	a. find and interpret gradients and intercepts of straight line graphs in practical contexts;	HB6.3	A3.3,A4.3, A5.4, A6.4, A6.5,N7.5, A8.7, A9.2
	b. construct linear functions from real life problems and plot their corresponding graphs;	HB6.1	
	c. discuss, plot and interpret graphs (which may be non-linear) modelling real situations, including journeys/travel graphs;	HC8.1	
	d. recognise and use graphs that illustrate direct proportion;	HC5.3	
	e. interpret the gradient at a point on a curve as a rate of change.		
H2M Algebraic manipulation			
1. Use trial and improvement to solve equations	a. find approximate solutions of equations using graphical method and systematic trial and improvement.	HC7.2	N4.6, A7.7
H2N Estimate areas			
Estimate areas	a. estimate areas of irregular shapes;		
	b. estimate areas under curves.		

H2O Pythagoras in 2D and 3D			
1. Use Pythagoras' theorem	a. understand, recall and use Pythagoras' theorem to solve simple cases in 2D;	HA13.1	S7.3, S9.2
	b. use Pythagoras' theorem to calculate lengths in three dimensions;	HA13.1	
	c. use Pythagoras theorem in 3D contexts.	HA13.1	
H2P Angles and properties of shapes			
1. Congruence and similarity	a. understand similarity and the relationship between areas and volumes in similar figures.	HB10.1	S8.4
H2Q Area and Volume			
1. Perimeter, area (including circles), and volume	a. find circumferences of circles and areas enclosed by circles, recalling relevant formulae;	HC10.1	S7.4, S7.5, S9.3, S10.1
	b. calculate volumes of right prisms and of shapes made from cubes and cuboids;	HC10.1	
	c. calculate the lengths of arcs and the areas of sectors of circles;	HC10.1	
	d. solve problems involving perimeter and surface areas of prisms, pyramids, cylinders, cones and spheres;	HC10.2	
	e. solve mensuration problems involving more complex shapes and solids, including segments of circles and frustums of cones.	HC10.2	
2. Use 2D representations of 3D shapes	a. explore the geometry of cuboids (including cubes) and objects made from cuboids;	HC10.2	S2.4, S3.3, S5.4, S6.3, S6.6
	b. use 2D representations of 3D objects; analyse 3D objects through 2D projections (including plan and elevation) and cross-sections;	HC10.2	
	c. construct nets of cubes, regular tetrahedra, square-based pyramids and other 3D shapes from given information.	HC10.2	

H2R Constructions			
1. Draw triangles and other 2-D shapes using a ruler and protractor	a. draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and angles.	HA10.1	S5.1, S6.3
2. Use straight edge and a pair of compasses to do constructions	a. use straight edge and compasses to do standard constructions, including;		
	i. an equilateral triangle with a given side,	HA10.2	S7.7
	ii. the midpoint and perpendicular bisector of a line segment,	HA10.2	
	iii. the perpendicular from a point to a line, the perpendicular from a point on line,	HA10.2	
iv. the bisector of an angle.	HA10.2		
3. Construct loci	a. find loci, by reasoning to produce shapes and paths.	HA10.3	S7.7
H2S Maps			
1. Maps and scale drawings	a. use and interpret maps and scale drawings.	HA11.1	S1.7, S2.6, S3.4, S5.2
H2T Trigonometry			
1. Trigonometry in 2D and 3D	a. use the trigonometrical ratios to solve 2D and 3D problems.	HC11.1	S9.2, S10.3

H2U Statistics and Probability			
1. Understand and use statistical problem solving process/handling data cycle	a. 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;	HA14.1	
	ii. collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources;	HA14.1	
	iii. process and represent the data: turn the raw data into usable information that gives insight into the problem;	HA14.1	
	iv. interpret and discuss the data: answer the initial question by drawing conclusions from the data.	HA14.1	
2. Experimenting	a. understand that when a statistical experiment or survey is repeated there will usually be different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics.	HA14.4	Not linked to a given unit.
3. Collecting	a. design an experiment or survey, identifying possible sources of bias;	HA14.2	D2.3
	b. design data-collection sheets distinguishing between different types of data;	HA14.2	
	c. extract data from publications, charts, tables and lists;	HA14.2	
	d. design, use and interpret two-way tables for discrete and grouped data.	HA14.2	

4. Processing	a. draw and interpret charts and diagrams for categorical data including bar charts, pie charts and pictograms;	HA14.3	D1.3, D2.2, D3.2, D3.3, D4.2, D5.2, D5.3, D6.3, D7.2, D8.2, D9.2
	b. produce and interpret diagrams for ungrouped discrete numerical data, including vertical line charts and stem and leaf diagrams;	HA14.3	
	c. calculate median, mean, range, quartiles and interquartile range, mode and modal class;	HA14.3	
	d. find the median for large, ungrouped, data sets.	HA14.3	
5. Interpreting	a. look at data to find patterns and exceptions;	HA14.4	D1.3, D3.3, D4.3, D5.2, D5.3, D6.3, D8.2, D8.3, D9.2, D10.1
	b. interpret a wide range of graphs and diagrams and draw conclusions;	HA14.4	
	c. interpret social statistics including index numbers; and survey data;	HA14.4	
	d. compare distributions and make inferences;	HA14.4	
	e. using the shapes of distributions and measures of average and range.	HA14.4	
6. Data handling	a. for grouped data, find the modal class, estimate mean, median, range, and mode;	HA14.3	D6.3, D7.2, D8.2
	b. calculate, and for grouped data estimate, the quartiles and interquartile range for large data sets.	HA14.3	
7. Use charts and correlation	a. draw and interpret scatter graphs;	HB12.1	D6.2, D7.3, D8.2, D9.2
	b. recognise correlation and draw and/or use lines of best fit by eye, understanding and interpreting what these represent, and appreciating that correlation does not imply causality;	HB12.1	
	c. work with time series and moving averages including their graphical representation;	HB12.1	
	d. produce and use cumulative frequency graphs and box plots;	HA14.3	
	e. produce and interpret diagrams for grouped discrete data and continuous data, including histograms with unequal class intervals.	HA14.3	

8. Probability and risk	a. understand and use the vocabulary of probability and the probability scale;	HC12.1	D1.1, D1.2, D2.1, D3.1, D4.1, D5.1, D6.1, D7.1, D8.1, D9.1, D10.3
	b. understand and use theoretical models for probabilities including the model of equally likely outcomes;	HC12.1	
	c. understand and use estimates of probability from relative frequency;	HC12.1	
	d. use probability to estimate risk and make a decision about a course of action.	HC12.1	

Methods in Mathematics

Foundation tier B391/01		Spec A J562 ref	Spec J517 ref
F1A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	FA1.1, FB1.1, FC1.1	
	b. 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;	FA1.1, FB1.1, FC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	FA1.1, FB1.1, FC1.1	
	d. use notation and symbols correctly and consistently within a problem;	FA1.1, FB1.1, FC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	FA1.1, FB1.1, FC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	FA1.1, FB1.1, FC1.1	
	g. present and interpret solutions in the context of the original problem;	FA1.1, FB1.1, FC1.1	
	h. review and justify their choice of mathematical presentation;	FA1.1, FB1.1, FC1.1	
	i. understand the importance of counter-example and identify exceptional cases when solving problems;	FA1.1, FB1.1, FC1.1	
	j. show step-by-step deduction in solving a problem;	FA1.1, FB1.1, FC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	FA1.1, FB1.1, FC1.1	

F1B Number			
1. Add, subtract, multiply and divide any number	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	FA2.1	N1.3, N1.4, N2.1, N2.2, N2.3, N2.4, N3.2, N3.3, N4.1, N4.3, N5.6, N6.3, N7.1
	b. add, subtract, multiply and divide integers and then any number;	FA2.1	
	c. multiply or divide any number by powers of 10;	FA2.1	
	d. multiply or divide any positive number by a number between 0 and 1;	FA2.1	
	e. multiply and divide by a negative number;	FA2.1	
	f. recall all positive integer complements to 100;	FB2.1	
	g. recall all multiplication facts to 10×10 , and use them to derive quickly the corresponding division facts;	FB2.1	
	h. develop a range of strategies for mental calculation; derive unknown facts from those they know;	FB2.1	
	i. add and subtract mentally numbers with up to two decimal places;	FB2.1	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	FB2.1	
	k. add and subtract integers and decimals understanding where to position the decimal point;	FB2.1	
l. perform a calculation involving division by a decimal (up to two decimal places) by transforming it to a calculation involving division by an integer.	FB2.1		
2. Approximate to a specified or appropriate degree of accuracy	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	FA2.2	N1.1, N5.1, N7.3
	b. estimate answers to problems involving decimals;	FB2.2	
	c. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	FB2.2	
	d. round to the nearest integer, to any number of decimal places, specified of appropriate, and to any number of significant figures;	FA2.2, FB2.2, FC2.2	
	e. 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.	FC2.2	
3. Understand and use Venn diagrams and set notation to solve problems	a. use 'two circle' Venn diagrams including in contexts other than number;		
	b. understand and use set notation to solve problems.		

F1C Hierarchy of operations			
1. Hierarchy of operations	a. use brackets and the hierarchy of operations.	FA3.1	F3.7, F6.5
F1D Factors, multiples and primes			
1. Factors, multiples and primes	a. use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple and prime number;	FA5.1	N1.2, N4.4, N7.7
	b. find the prime factor decomposition of positive integers;	FA5.1	
	c. understand that the number of factors of a number can be derived from its prime factorisation.	FA5.1	
F1E Fractions, decimals and percentages			
1. Calculate with fractions	a. calculate a given fraction of a given quantity, expressing the answer as a fraction;	FB3.1, FC2.1	N1.5, N2.6, N3.4, N5.3, N5.5, N6.3, N6.4, N7.7, N8.4
	b. express a given number as a fraction of another;	FB3.1, FC2.1	
	c. add and subtract fractions by writing them with a common denominator;	FB3.1, FC2.1	
	d. convert a simple fraction to a decimal;	FB3.1, FC2.1	
	e. multiply and divide a fraction by an integer and by a unit fraction;	FB3.1, FC2.1	
	f. understand and use unit fractions as multiplicative inverses;	FB3.1, FC2.1	
	g. use efficient methods to calculate with fractions, including cancelling common factors before carrying out a calculation.	FB3.1, FC2.1	
2. Order rational numbers	a. order integers;	FB3.2	N1.1, N4.2, N6.4
	b. order fractions;	FB3.2	
	c. order decimals.	FB3.2	
3. Understand equivalent fractions	a. understand equivalent fractions and simplify a fraction by cancelling all common factors.	FB3.3	N5.3
4. Relationship between fractions and decimals	a. use decimal notation and recognise that each terminating decimal is a fraction;	FB3.4	N4.1, N7.1, N10.2
	b. distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by terminating decimals), and other fractions).	HB3.4	

F1F Indices and surds			
1. Indices in common use	a. use the terms 'square', 'positive square root', 'negative square root', 'cube' and 'cube root';	FB4.1	N3.1, N5.2, N7.2
	b. recall integer squares from 11×11 to 15×15 and the corresponding square roots;	FB4.1	
	c. recall the cubes of 2, 3, 4, 5 and 10.	FB4.1	
2. Use index notation	a. use index notation for squares, cubes and powers of 10;	FB4.2	N3.1, N5.2, N7.2
	b. use index notation for simple positive integer powers;	FB4.2	
	c. use index laws for multiplication and division of integer powers;	FB4.2	
	d. use index laws to simplify, and calculate the value of, numerical expressions involving multiplication and division of integer powers.	FB4.2	
F1G Algebra			
1. Symbols and notation	a. distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number;	FA6.1, FB5.1, FC5.1	
	b. know that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae and general, unspecified independent numbers in identities;	FA6.1, FB5.1, FC5.1	
	c. know that in functions, letter symbols define new expressions or quantities by referring to known quantities.	FA6.1, FB5.1, FC5.1	
F1H Coordinates			
1. Use the conventions for coordinates in the plane	a. use the conventions for coordinates in the plane; plot points in all four quadrants;	FA6.3, FB5.3, FC5.3	A1.3, S4.4, S7.6
	b. understand that one coordinate identifies a point on a number line, two coordinates identify a point in a plane, using the terms '1D', and '2D';	FA6.3, FB5.3, FC5.3	
	c. use axes and coordinates to specify points in all four quadrants;	FA6.3, FB5.3, FC5.3	
	d. locate points with given coordinates.	FA6.3, FB5.3, FC5.3	

F1I Sequences and formulae			
1. Understand and use formulae	a. substitute numbers into formulae.	FA7.1	A2.2, A3.2, A5.1, A6.3, A7.1
F1 J Linear equations			
1. Manipulate algebraic expressions	a. understand that the transformation of algebraic expressions obeys and generalises the rules of generalised arithmetic;	FA8.1, FC6.1	A5.3, A6.1
	b. manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors;	FA8.1, FC6.1	
	c. use index laws in algebra.	FB4.2	
2. Set up and solve simple equations and inequalities	a. set up simple equations;	FA8.2	A1.2, A3.1, A5.2, A6.2, A7.2
	b. solve simple equations by transforming both sides in the same way;	FA8.2	
	c. solve linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation.	FA8.2	
F1K Functions and graphs			
1. Recognise and plot equations that correspond to straight-line graphs in the coordinate plane, including finding gradients	a. plot graphs of functions in which y is given explicitly or implicitly in terms of x , where a table and/or axes are provided and where no table or axes are given;	FB6.3	A5.4, A6.4, A8.7
	b. read off values of x - or y - coordinates where two lines cross, where a line meets an axis, or where one coordinate is given.	FB6.3	
2. Use geometric information to complete diagrams on a coordinate grid	a. use geometric information about shapes, or parallel or perpendicular lines, to complete diagrams on a coordinate grid.		

F1L Angles and properties of shapes			
1. Lines and angles	a. recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles;	FB9.1	S2.1, S2.3, S4.2, S6.1, S7.2
	b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees.	FB9.1	
2. Properties of shapes	a. use angle properties of equilateral, isosceles and right-angled triangles;	FB9.2	S1.5, S4.2, S5.3, S6.1, S6.2, S6.3
	b. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus;	FB9.2	
	c. classify quadrilaterals by their geometric properties;	FB9.2	
	d. recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment;	FB9.2	
	e. understand that inscribed regular polygons can be constructed by equal division of a circle;	FB9.2	

F1M Transformations

1. Properties of shapes	a. recognise and visualise rotations, reflections and translations, including reflection symmetry of 2D and 3D shapes, and rotation symmetry of 2D shapes;	FB10.2	S1.6, S2.5, S3.5, S4.5, S4.6, S5.5, S6.7, S6.8, S8.2
	b. understand that rotations are specified by a centre and an (anticlockwise) angle;	FB10.2	
	c. understand that reflections are specified by a mirror line, at first using a line parallel to an axis, then a mirror line such as $y = x$ or $y = -x$;	FB10.2	
	d. understand that translations are specified by a vector;	FB10.2	
	e. transform triangles and other 2-D shapes by translation, rotation and reflection and by combinations of these transformations;	FB10.2	
	f. recognise that these transformations preserve length and angle, and hence that any figure is congruent to its image under any of these transformations;	FB10.2	
	g. understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not;		
	h. understand that enlargements are specified by a centre;	FB10.2	
	i. describe and transform enlargements of shapes using positive scale factors;	FB10.2	
	j. distinguish properties that are preserved under particular transformations;	FB10.2	
	k. identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments and apply this to triangles;	FB10.2	
l. understand and use vector notation for translations.	FB10.2		

F1N Area and Volume			
1. Perimeter, area and volume	a. find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach;	FC9.1	S1.3, S1.4, S4.3, S5.4, S6.4, S6.5, S7.4, S7.5
	b. find the area of a parallelogram and a triangle;	FC9.1	
	c. work out the surface area of simple shapes composed of triangles and rectangles;	FC9.1	
	d. calculate perimeters and areas of shapes made from triangles and rectangles.	FC9.1	
F1O Probability			
1. Probability	a. understand and use the vocabulary of probability and the probability scale;	FC10.1	
	b. understand and use theoretical models of probabilities including the model of equally likely outcomes;	FC10.1	
	c. understand and use estimates of probability from relative frequency;	FC10.1	
	d. use sample spaces for situations where outcomes are single events and for situations where outcomes are two successive events;	FC10.1	
	e. identify different mutually-exclusive and exhaustive outcomes and know that the sum of the probabilities of these outcomes is 1;	FC10.1	
	f. 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;	FC10.1	
	g. compare experimental data to theoretical probabilities, and make informal inferences about the validity of the model giving rise to the theoretical probabilities;	FC10.1	
	h. understand and use set notation to describe events and compound events;		
	i. use Venn diagrams to represent the number of possibilities and hence find probabilities;		

Foundation tier B392/01		Spec A J562 ref	Spec J517 ref
F2A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	FA1.1, FB1.1, FC1.1	
	b. 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;	FA1.1, FB1.1, FC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	FA1.1, FB1.1, FC1.1	
	d. use notation and symbols correctly and consistently within a problem;	FA1.1, FB1.1, FC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	FA1.1, FB1.1, FC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	FA1.1, FB1.1, FC1.1	
	g. present and interpret solutions in the context of the original problem;	FA1.1, FB1.1, FC1.1	
	h. review and justify their choice of mathematical presentation;	FA1.1, FB1.1, FC1.1	
	i. understand the importance of counter-example and identify exceptional cases when solving problems;	FA1.1, FB1.1, FC1.1	
	j. show step-by-step deduction in solving a problem;	FA1.1, FB1.1, FC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	FA1.1, FB1.1, FC1.1	

F2B Number			
1. Approximate to a specified or appropriate degree of accuracy	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	FA2.2	N1.1, N5.1, N7.3
	b. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	FB2.2	
	c. round to the nearest integer, to any number of decimal places, specified or appropriate, and to any number of significant figures;	FB2.2, FC2.2	
	d. 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;	FA2.2, FB2.2, FC2.2	
	e. 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.	FC2.2	
F2C Hierarchy of operations			
2. Use calculators effectively and efficiently	a. use calculators effectively and efficiently;	FA2.3, FC2.3	N6.1
	b. know how to enter complex calculations and use function keys for reciprocals, squares and powers;	FA2.3, FC2.3	
	c. enter a range of calculations, including those involving measures.	FA2.3, FC2.3	
F2D Ratio			
1. Hierarchy of operations	a. understand and use number operations and the relationships between them, including inverse operations.	FA3.1	F3.7, F6.5
F2D Ratio			
1. Use ratio notation, including reduction to its simplest form and its various links to fraction notation	a. use ratio notation, including reduction to its simplest form expressed as $1:n$ or $n:1$ or $m:n$;	FA4.1	N6.2
	b. know and use the links between ration notation and fraction notation.	FA4.1	
F2D Ratio			
2. Divide a quantity in a given ratio	a. divide a quantity in a given ratio;	FA4.2	N4.5, N6.2, N7.4
	b. determine the original quantity by knowing the size of one part of the divided quantity;	FA4.2	
	c. solve word problems about ratio, including using informal strategies and the unitary method of solution.	FA4.2	

F2E Fractions, decimals and percentages			
1. Calculate with fractions	a. convert a simple fraction to a decimal;	FB3.1	N1.5, N2.6, N3.4, N5.3, N5.5, N6.3, N6.4, N7.7, N8.4
	b. multiply and divide a fraction by an integer and by a unit fraction;	FB3.1, FC2.1	
	c. understand and use unit fractions as multiplicative inverses;	FB3.1, FC2.1	
	d. use efficient methods to calculate with fractions, including cancelling common factors before carrying out a calculation;	FB3.1	
	e. recognise that, in some cases, only a fraction can express the exact answer;	FB3.1	
	f. understand 'reciprocal' as multiplicative inverse and know that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, since division by zero is not defined).	FB3.1	
2. Relationship between fractions and decimals	a. recognise that recurring decimals are exact fractions;	FB3.4	N4.2, N7.1
	b. know that some exact fractions are recurring decimals;	FB3.4	
	c. convert a recurring decimal to a fraction.	FB3.4	
3. Understand percentage	a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions;	FB3.5	N2.5, N5.4, N7.6
	b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	FB3.5	
4. Interpret fractions, decimals and percentages as operators	a. interpret percentage as the operator 'so many hundredths of';	FB3.6	N2.5, N5.4, N5.5, N7.6
	b. convert between fractions, decimals and percentages;	FB3.6	
	c. understand the multiplicative nature of percentages as operators;	FB3.6	
	d. use multipliers for percentage change.	FC4.2	
5. Proportional change	a. find proportional change using fractions, decimals and percentages;	FC4.3	N7.5
	b. understand and use direct proportion.	FC4.3	

F2F Algebra			
1. Symbols and notation	a. distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number;	FA6.1, FB5.1, FC5.1	
	b. know that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae and general, unspecified independent numbers in identities;	FA6.1, FB5.1, FC5.1	
	c. know that in functions, letter symbols define new expressions or quantities by referring to known quantities.	FA6.1, FB5.1, FC5.1	
	d. understand the concept of an inequality.		
2. Proof	a. use algebra to support and construct arguments.		
F2G Coordinates			
1. Use the conventions for coordinates in the plane	a. given the coordinates of points A and B, find the coordinates of the midpoint of the line segment AB;	FA6.3	A1.3, S4.4, S7.6
	b. given the coordinates of points A and B, calculate the length AB.	FA6.3	
F2H Sequences and formulae			
1. Generate terms of a sequence using term-to-term and position-to-term definitions of the sequence	a. generate terms of a sequence using term-to-term and position-to-term definitions of the sequence;	FA7.2	A1.1, A2.1, A4.2
	b. generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers).	FA7.2	
2. Form linear expressions to describe the n th term of an arithmetic sequence	a. use linear expressions to describe the n th term of an arithmetic sequence, justifying its form by referring to the activity or context from which it was generated.	FA7.3	A7.8
3. Derive a formula, substitute numbers into a formula and change the subject of a formula	a. derive a formula for a given sequence;	FA7.1	A2.2, A3.2, A4.1, A5.1, A6.3, A7.1, A7.3
	b. derive a formula in a physical or everyday context;	FA7.1	
	c. substitute numbers into a formula;	FA7.1	
	d. change the subject of a formula.	FA7.1	

F2I Linear equations			
1. Set up and solve simple equations and inequalities	a. 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;	FA8.2	A1.2, A3.1, A5.2, A6.2, A7.2, A7.6
	b. understand that the point of intersection of two different lines in the same two variables that simultaneously describe a real situation is the solution to the simultaneous equations represented by the lines;	FB6.2	
	c. set up simple inequalities;	FB7.1	
	d. solve simple inequalities by transforming both sides in the same way.	FB7.1	
F2J Functions and graphs			
1. Solve quadratic equations using a graph	a. understand that approximate solutions of quadratic equations can be found from their graphs;	FC7.2	A7.5
	b. draw graphs of quadratic equations and find their approximate solution.	FC7.2	
2. Recognise and use equivalence in numerical, algebraic and graphical representations	a. recognise that straight-line graphs can be represented by equations, and vice versa;		
	b. interpret numerical data in graphical form.		
F2K Pythagoras in 2D			
1. Use Pythagoras' theorem	a. understand, recall and use Pythagoras' theorem to solve simple cases in 2D.	FA12.1	S7.3

F2L Angles and properties of shapes			
1. Lines and angles	a. distinguish between lines and line segments;	FB9.1	S1.5, S2.1, S2.3, S4.2, S5.3, S6.1, S6.2, S7.2
	b. use parallel lines, alternate angles and corresponding angles;	FB9.1	
	c. understand the consequent properties of parallel and intersecting lines, triangles (including a proof that the angle sum of a triangle is 180°) and parallelograms;	FB9.1	
	d. understand a proof that an exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices;	FB9.1	
	e. explain why the angle sum of a quadrilateral is 360° .	FB9.2	
2. Angles and polygons	a. calculate and use the sums of the interior and exterior angles of polygons;	FB9.3	
	b. calculate and use the angles of regular polygons;	FB9.3	
	c. solve problems in the context of tiling patterns and tessellations.		
F2M Transformations			
1. Congruence and similarity	a. understand congruence;	FB10.1	S6.8, S8.4
	b. understand similarity of plane figures including the relationship between lengths.	FB10.1	
F2N Area and Volume			
1. Perimeter, area (including circles), and volume	a. solve problems involving simple areas;	FC9.1	S1.4, S4.3, S5.4, S6.4, S6.5, S7.4, S7.5
	b. find circumferences of circles and areas enclosed by circles, recalling relevant formulae;	FC9.1	
	c. find volumes of cuboids, recalling the formula and understanding the connection to counting cubes and how it extends this approach;	FC9.1	
	d. calculate volumes of right prisms and of shapes made from cubes and cuboids.		

Higher tier B391/02		Spec A J562 ref	Spec J517 ref
H1A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	HA1.1, HB1.1, HC1.1	
	b. 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;	HA1.1, HB1.1, HC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	HA1.1, HB1.1, HC1.1	
	d. use notation and symbols correctly and consistently within a problem;	HA1.1, HB1.1, HC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	HA1.1, HB1.1, HC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	HA1.1, HB1.1, HC1.1	
	g. present and interpret solutions in the context of the original problem;	HA1.1, HB1.1, HC1.1	
	h. review and justify their choice of mathematical presentation;	HA1.1, HB1.1, HC1.1	
	i. understand the importance of counter-example and identify exceptional cases when solving problems;	HA1.1, HB1.1, HC1.1	
	j. show step-by-step deduction in solving a problem;	HA1.1, HB1.1, HC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	HA1.1, HB1.1, HC1.1	

H1B Number			
1. Add, subtract, multiply and divide any number	a. understand and use positive numbers and negative integers, both as positions and translations on a number line;	HA2.1	N1.3, N1.4, N2.1, N2.2,
	b. add, subtract, multiply and divide integers and then any number;	HA2.1	
	c. multiply or divide any number by powers of 10;	HA2.1	
	d. multiply or divide any positive number by a number between 0 and 1;	HA2.1	
	e. multiply and divide by a negative number;	HA2.1	N2.3, N2.4, N3.2, N3.3, N4.1, N4.3 N5.6, N6.3 N7.1
	f. recall all positive integer complements to 100;	HB2.1, HC2.1	
	g. recall all multiplication facts to 10×10 , and use them to derive quickly the corresponding division facts;	HB2.1	
	h. develop a range of strategies for mental calculation; derive unknown facts from those they know;	HB2.1, HC2.1	
	i. add and subtract mentally numbers with up to two decimal places;	HB2.1	
	j. multiply and divide numbers with no more than one decimal place, using place value adjustments, factorisation and the commutative, associative, and distributive laws, where possible;	HB2.1	
	k. add and subtract integers and decimals understanding where to position the decimal point;	HB2.1	
l. perform a calculation involving division by a decimal (up to two decimal places) by transforming it to a calculation involving division by an integer.	HB2.1		
2. Approximate to a specified or appropriate degree of accuracy	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	HA2.2	N1.1, N5.1, N7.3, N9.2
	b. estimate answers to problems involving decimals;	HB2.2	
	c. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	HB2.2	
	d. round to the nearest integer, to any number of decimal places, specified of appropriate, and to any number of significant figures;	HA2.2, HB2.2, HC2.2	
	e. 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.	HB2.2, HC2.2	
3. Understand and use Venn diagrams and set notation to solve problems	a. use 'two circle' Venn diagrams including in contexts other than number;		
	b. understand and use set notation to solve problems.		

H1C Hierarchy of operations			
1. Hierarchy of operations	a. use brackets and the hierarchy of operations.	HA3.1	F3.7, F6.5
H1D Factors, multiples and primes			
1. Factors, multiples and primes	a. use the concepts and vocabulary of factor (divisor), multiple, common factor, common multiple and prime number;	HA5.1	N1.2, N4.4, N7.7
	b. find the prime factor decomposition of positive integers;	HA5.1	
	c. understand that the number of factors of a number can be derived from its prime factorisation.	HA5.1	
H1E Fractions, decimals and percentages			
1. Calculate with fractions	a. calculate a given fraction of a given quantity, expressing the answer as a fraction;	HB3.1	N1.5, N2.6, N3.4, N5.3, N5.5, N6.3, N6.4, N7.7, N8.4
	b. express a given number as a fraction of another;	HB3.1	
	c. add and subtract fractions by writing them with a common denominator;	HB3.1	
	d. perform short division to convert a simple fraction to a decimal;	HB3.1	
	e. multiply and divide a fraction by an integer and by a unit fraction;	HB3.1	
	f. understand and use unit fractions as multiplicative inverses;	HB3.1	
	g. use efficient methods to calculate with fractions, including cancelling common factors before carrying out a calculation.	HB3.1	
2. Order rational numbers	a. order integers;	HB3.2	N1.1, N4.2, N6.4
	b. order fractions;	HB3.2	
	c. order decimals.	HB3.2	
3. Understand equivalent fractions	a. understand equivalent fractions and simplify a fraction by cancelling all common factors.	HB3.3	N5.3
4. Relationship between fractions and decimals	a. use decimal notation and recognise that each terminating decimal is a fraction;	HB3.4	N4.2, N7.1, N10.2
	b. distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by terminating decimals), and other fractions).	HB3.4	

H1F Indices and surds			
1. Indices in common use	a. use the terms 'square', 'positive square root', 'negative square root', 'cube' and 'cube root';	HB4.1	N3.1, N5.2, N7.2
	b. recall integer squares from 11×11 to 15×15 and the corresponding square roots;	HB4.1	
	c. recall the cubes of 2, 3, 4, 5 and 10.	HB4.1	
2. Index notation	a. use index notation for squares, cubes and powers of 10;	HB4.2	N3.1, N5.2, N7.2, N9.3
	b. use index notation for simple positive integer powers;	HB4.2	
	c. use index laws for multiplication and division of integer powers;	HB4.2	
	d. use index laws to simplify, and calculate the value of, numerical expressions involving multiplication and division of integer, fractional and negative powers;	HB4.2	
	e. know that $n^0 = 1$; understand that the inverse operation of raising a positive number to power n is raising the result of this operation to power $1/n$;	HB4.2	
	f. know that $n^{-1} = 1/n$ (undefined for $n = 0$), and that $n^{1/2} = \sqrt{n}$ and $n^{1/3} = \sqrt[3]{n}$ for any positive number n .	HB4.2	
3. Use surds in exact calculations	a. use surds and π in exact calculations without a calculator;	HB4.3	N10.2
	b. rationalise a denominator.	HB4.3	
H1G Standard index form			
Standard index form	a. use and express standard index form expressed in conventional notation;	HC3.1	N8.3, N9.2
	b. calculate with standard index form;	HC3.1	
	c. convert between ordinary and standard index form representations, converting to standard index form to make sensible estimates for calculations involving multiplication and/or division.	HC3.1	

H1H Algebra			
1. Symbols and notation	a. distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number;	HA6.1, HB5.1, HC5.1	
	b. know that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae and general, unspecified independent numbers in identities;	HA6.1, HB5.1, HC5.1	
	c. know that in functions, letter symbols define new expressions or quantities by referring to known quantities.	HA6.1, HB5.1, HC5.1	
H1I Coordinates			
1. Use the conventions for coordinates in the plane	a. use the conventions for coordinates in the plane; plot points in all four quadrants;	HA6.3, HB5.3, HC6.3	A1.3, S4.4, S7.6, S9.2
	b. 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 '1D', '2D' and '3D';	HA6.3, HB5.3, HC6.3	
	c. use axes and coordinates to specify points in all four quadrants;	HA6.3, HB5.3, HC6.3	
	d. locate points with given coordinates.	HA6.3, HB5.3, HC6.3	
H1J Sequences and formulae			
1. Use formulae	a. substitute numbers into a formula.	HA7.1	A2.2, A3.2, A5.1, A6.3, A7.1

H1K Linear equations			
1. Manipulate algebraic expressions	a. understand that the transformation of algebraic expressions obeys and generalises the rules of generalised arithmetic;	HA8.1	A5.3, A6.1
	b. manipulate algebraic expressions by collecting like terms, by multiplying a single term over a bracket, and by taking out common factors;	HA8.1	
	c. use index laws in algebra.	HB4.2	
2. Set up and solve simple equations	a. set up simple equations;	HA8.2	A3.1, A5.2, A6.2, A7.2
	b. solve simple equations by transforming both sides in the same way;	HA8.2	
	c. solve simple linear equations, with integer coefficients, in which the unknown appears on either side or on both sides of the equation.	HA8.2	
H1L Functions and graphs			
1. Recognise and plot equations that correspond to straight-line graphs in the coordinate plane, including finding gradients	a. 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;	HB6.3	A5.4, A6.4, A8.7, A9.4
	b. find the gradient of lines given by equations of the form $y = mx + c$ (when values are given for m and c); investigate the gradients of parallel lines;	HB6.3	
	c. plot graphs of functions in which y is given explicitly in terms of x , or implicitly, where no table or axes are given;	HB6.3	
	d. use $y = mx + c$ and understand the relationship between gradients of parallel and perpendicular lines.	HB6.4	
2. Use geometric information to complete diagrams on a coordinate grid	a. use geometric information about shapes, or parallel or perpendicular lines, to complete diagrams on a coordinate grid.		

H1M Angles and properties of shapes			
1. Lines and angles	a. recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles;	HB9.1	S2.3, S4.2, S6.1, S7.2
	b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees.	HB9.1	
2. Properties of shapes	a. use angle properties of equilateral, isosceles and right-angled triangles;	HB9.2	S1.5, S4.2, S5.3, S6.1, S6.2, S6.3
	b. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium, kite and rhombus;	HB9.2	
	c. classify quadrilaterals by their geometric properties;	HB9.2	
	d. understand that inscribed regular polygons can be constructed by equal division of a circle;	HB9.2	
	e. distinguish between centre, radius, chord, diameter, circumference, tangent, arc, sector and segment.	HB9.2	
3. Understand, prove and use circle theorems	a. understand and use the fact that the tangent at any point on a circle is perpendicular to the radius at that point;	HB9.4	S9.1
	b. understand and use the fact that tangents meeting at an external point are equal in length;	HB9.4	
	c. explain why the perpendicular from the centre to a chord bisects that chord;	HB9.4	
	d. prove and use these facts:		
	i. the angle subtended by an arc at the centre of a circle is twice the angle subtended at any point on the circumference;	HB9.4	
	ii. the angle subtended at the circumference in a semicircle is a right angle;	HB9.4	
	iii. angles in the same segment are equal;	HB9.4	
	iv. the alternate segment theorem;	HB9.4	
	v. the opposite angles of a cyclic quadrilateral sum to 180° .	HB9.4	

H1N Transformations			
1. Transformations of 2D shapes	a. recognise and visualise rotations, reflections and translations, including reflection symmetry of 2D and 3D shapes, and rotation symmetry of 2D shapes;	HB10.2	S1.6, S2.5, S3.5, S4.5, S4.6, S5.5, S6.7, S6.8, S8.2, S9.4
	b. understand that rotations are specified by a centre and an (anticlockwise) angle;	HB10.2	
	c. understand that reflections are specified by a mirror line, at first using a line parallel to an axis, then a mirror line such as $y = x$ or $y = -x$;	HB10.2	
	d. understand that translations are specified by a vector;	HB10.2	
	e. transform triangles and other 2D shapes by translation, rotation and reflection and by combinations of these transformations;	HB10.2	
	f. recognise that these transformations preserve length and angle, and hence that any figure is congruent to its image under any of these transformations;	HB10.2	
	g. understand that enlargements are specified by a centre;	HB10.2	
	h. describe and transform enlargements of shapes using positive scale factors;	HB10.2	
	i. understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not;	HB10.2	
	j. distinguish properties that are preserved under particular transformations;	HB10.2	
	k. recognise that these transformations preserve length and angle, and hence that any figure is congruent to its image under any of these transformations;	HB10.2	
	l. understand that enlargements are specified by a centre;	HB10.2	
	m. describe and transform enlargements of shapes using positive scale factors;	HB10.2	
	n. understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not;	HB10.2	
	o. distinguish properties that are preserved under particular transformations;	HB10.2	
	p. identify the scale factor of an enlargement as the ratio of the lengths of any two corresponding line segments and apply this to triangles;	HB10.2	
	q. enlarge shapes using positive, fractional and negative scale factors.	HB10.2	
H1O Vectors			
1. Use vectors	a. understand and use vector notation for translations;	HB11.1	S10.5
	b. solve simple geometrical problems using vector methods;	HB11.1	
	c. use vector methods to construct geometrical arguments.	HB11.1	

H1P Area and Volume			
1. Perimeter, area and volume	a. find areas of rectangles, recalling the formula, understanding the connection to counting squares and how it extends this approach;	HB10.1	S1.4, S4.3, S5.4, S6.4, S6.5, S7.4, S7.5, S9.3, S10.1
	b. find the area of a parallelogram and a triangle;	HB10.1	
	c. calculate perimeters and areas of shapes made from triangles and rectangles;	HB10.1	
	d. work out the surface area of simple shapes composed of triangles and rectangles;	HB10.1	
	e. find volumes of cuboids, recalling the formula.	HB10.1	
2. Use 2D representations of 3D shapes	a. use 2D representations of 3D shapes, including plans and elevations.	HC10.2	S3.3, S6.6

H1Q Probability			
1. Probability	a. understand and use the vocabulary of probability and the probability scale;	HC12.1	D1.1, D1.2, D2.1, D3.1, D4.1, D5.1, D6.1, D7.1, D8.1, D9.1, D10.3
	b. understand and use theoretical models of probabilities including the model of equally likely outcomes;	HC12.1	
	c. understand and use estimates of probability from relative frequency;	HC12.1	
	d. use sample spaces for situations where outcomes are single events and for situations where outcomes are two successive events;	HC12.1	
	e. identify different mutually-exclusive and exhaustive outcomes and know that the sum of the probabilities of these outcomes is 1;	HC12.1	
	f. 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;	HC12.1	
	g. compare experimental data to theoretical probabilities, and make informal inferences about the validity of the model giving rise to the theoretical probabilities;	HC12.1	
	h. know when to add or multiply two probabilities: if A and B are mutually exclusive, then the probability of A or B occurring is $P(A) + P(B)$; if A and B are independent events, the probability of A and B occurring is $P(A) \times P(B)$;	HC12.1	
	i. use tree diagrams to represent outcomes of compound events, recognising when events are independent or dependent;	HC12.1	
	j. understand and use set notation to describe events and compound events;	HC12.1	
	k. use Venn diagrams to represent the number of possibilities and hence find probabilities.	HC12.1	

Higher tier B392/02		Spec A J562 ref	Spec J517 ref
H2A General problem solving skills			
Solve problems using mathematical skills	a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems;	HA1.1, HB1.1, HC1.1	
	b. 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;	HA1.1, HB1.1, HC1.1	
	c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods;	HA1.1, HB1.1, HC1.1	
	d. use notation and symbols correctly and consistently within a problem;	HA1.1, HB1.1, HC1.1	
	e. use a range of strategies to create numerical representations of a problem and its solution; move from one form of representation to another in order to get different perspectives on the problem;	HA1.1, HB1.1, HC1.1	
	f. interpret and discuss numerical information presented in a variety of forms;	HA1.1, HB1.1, HC1.1	
	g. present and interpret solutions in the context of the original problem;	HA1.1, HB1.1, HC1.1	
	h. review and justify their choice of mathematical presentation;	HA1.1, HB1.1, HC1.1	
	i. understand the importance of counter-example and identify exceptional cases when solving problems;	HA1.1, HB1.1, HC1.1	
	j. show step-by-step deduction in solving a problem;	HA1.1, HB1.1, HC1.1	
	k. recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying those assumptions may have on the solution to a problem.	HA1.1, HB1.1, HC1.1	

H2B Number			
1. Approximate to a specified or appropriate degree of accuracy	a. use their previous understanding of integers and place value to deal with arbitrarily large positive numbers;	HA2.2	N1.1, N5.1, N7.3, N9.2
	b. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude;	HB2.2, HB2.2	
	c. round to the nearest integer, to any number of decimal places, specified or appropriate, and to any number of significant figures;	HA2.2, HB2.2	
	d. 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;	HB2.2, HC2.2	
	e. 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.	HC2.2	
2. Use calculators effectively and efficiently	a. use calculators effectively and efficiently;	HA2.3	N6.1
	b. perform a calculation involving division by a decimal (up to two decimal places);		
	c. know how to enter complex calculations and use function keys for reciprocals, squares and powers;	HA2.3	
	d. know how to calculate with numbers expressed in standard index form, and be able to interpret calculator displays of such numbers;	HC3.1	
	e. perform a range of calculations, including those involving measures;	HA2.3	
	f. use an extended range of function keys, including trigonometrical functions.	HC2.3	
H2C Hierarchy of operations			
1. Hierarchy of operations	a. understand and use number operations and the relationships between them, including inverse operations.	HA3.1	F3.7, F6.5

H2D Ratio			
1. Use ratio notation, including reduction to its simplest form and its various links to fraction notation	a. use ratio notation, including reduction to its simplest form expressed as $1:n$ or $n:1$ or $m:n$;	HA4.1	N6.2
	b. know and use the links between ration notation and fraction notation.	HA4.1	
2. Divide a quantity in a given ratio	a. divide a quantity in a given ratio;	HA4.2	N4.5, N6.2, N7.4
	b. determine the original quantity by knowing the size of one part of the divided quantity;	HA4.2	
	c. solve word problems about ratio, including using informal strategies and the unitary method of solution.	HA4.2	
H2E Fractions, decimals and percentages			
1. Calculate with fractions	a. perform short division to convert a simple fraction to a decimal;	HB3.1	N1.5, N2.6, N3.4, N5.3, N5.5, N6.3, N6.4, N7.7, N8.4
	b. multiply and divide a fraction by an integer and by a unit fraction;	HB3.1	
	c. understand and use unit fractions as multiplicative inverses;	HB3.1	
	d. use efficient methods to calculate with fractions, including cancelling common factors before carrying out a calculation;	HB3.1	
	e. recognise that, in some cases, only a fraction can express the exact answer;	HB3.1	
	f. understand 'reciprocal' as multiplicative inverse and know that any non-zero number multiplied by its reciprocal is 1 (and that zero has no reciprocal, since division by zero is not defined).	HB3.1	
2. Relationship between fractions and decimals	a. recognise that recurring decimals are exact fractions;	HB3.4	N4.2, N7.1, N10.2
	b. know that some exact fractions are recurring decimals;	HB3.4	
	c. convert a recurring decimal to a fraction.	HB3.4	
3. Understand percentage	a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions;	HB3.5	N2.5, N5.4, N7.6
	b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	HB3.5	

4. Interpret fractions, decimals and percentages as operators	a. interpret percentage as the operator 'so many hundredths of';	HB3.6	N2.5, N5.4, N7.6
	b. convert between fractions, decimals and percentages;	HB3.6	
	c. understand the multiplicative nature of percentages as operators;	HB3.6	
	d. use multipliers for percentage change;	HC5.2	
	e. work with repeated percentage change;	HC5.2	
	f. solve reverse percentage problems.	HC2.3	
5. Proportional change.	a. find proportional change using fractions, decimals and percentages;	HC5.3	N7.5, A9.2
	b. understand and use direct proportion;	HC5.3	
	c. set up and use equations to solve problems involving inverse proportion;	HC5.3	
	d. understand and use repeated proportional change.	HC5.3	
H2F Algebra			
1. Symbols and notation	a. distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number;	HA6.1, HB5.1, HC6.1	
	b. know that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae and general, unspecified independent numbers in identities;	HA6.1, HB5.1, HC6.1	
	c. know that in functions, letter symbols define new expressions or quantities by referring to known quantities.	HA6.1, HB5.1, HC6.1	
2. Algebraic terminology	a. distinguish in meaning between the words 'equation', 'inequality', 'formula', 'identity' and 'expression'.	HA6.1	
3. Proof	a. use algebra to support and construct arguments.		
H2G Coordinates			
1. Use the conventions for coordinates in the plane	a. given the coordinates of points A and B, find the coordinates of the midpoint of the line segment AB;	HA6.3	A1.3, S4.4, S7.6, S9.2
	b. given the coordinates of points A and B, calculate the length AB.	HA6.3	

H2H Sequences and formulae			
1. Derive a formula, substitute numbers into a formula and change the subject of a formula	a. substitute numbers into a formula;	HA7.1	A2.2, A3.2, A4.1, A5.1, A6.3, A7.1, A7.3
	b. derive a formula;	HA7.1	
	c. change the subject of a formula.	HA7.1	
2. Generate terms of a sequence using term-to-term and position-to-term definitions of the sequence	a. generate terms of a sequence using term-to-term and position-to-term definitions of the sequence;	HA7.2	A1.1, A2.1, A4.2
	b. generate common integer sequences (including sequences of odd or even integers, squared integers, powers of 2, powers of 10, triangular numbers).	HA7.2	
3. Form linear expressions to describe the n th term of an arithmetic sequence	a. use linear expressions to describe the n th term of an arithmetic sequence, justifying its form by referring to the activity or context from which it was generated.	HA7.3	A7.8
4. Form quadratic expressions to describe the n th term of a sequence	a. form quadratic expressions to describe the n th term of a sequence.		
H2I Linear equations			
1. Set up and solve simple equations and inequalities	a. set up linear inequalities;	HB7.1	A2.2, A3.2, A4.1, A5.1, A6.3, A7.1, A7.3
	b. solve simple inequalities by transforming both sides in the same way;	HB7.1	
	c. 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;	HB7.1	
	d. understand that the point of intersection of two different lines in the same two variables that simultaneously describe a real situation is the solution to the simultaneous equations represented by the lines.	HB6.2	

H2J Algebraic manipulation			
1. Manipulate algebraic expressions	a. set up and use equations that describe direct and indirect proportion;	HC5.3	N7.5, A5.3, A6.1, A7.4, A8.2, A9.2, A9.3, A10.1, A10.2, A10.3
	b. expand the product of two linear expressions;	HC7.1	
	c. factorise quadratic expressions including the difference of two squares and simplifying rational expressions;	HC7.1	
	d. solve quadratic equations exactly by factorising, completing the square and using the formula;	HC7.3	
	e. set up and solve simultaneous equations in two unknowns, where one of the equations might include squared terms in one or both unknowns.	HC7.3	
H2K Functions and graphs			
1. Solve quadratic equations using a graph	a. understand that approximate solutions of quadratic equations can be found from their graphs;	HC8.2	A7.5
	b. draw graphs of quadratic equations and find their approximate solution.	HC8.2	
2. Recognise and use equivalence in numerical, algebraic and graphical representations	a. recognise that straight-line graphs can be represented by equations, and vice versa;		
	b. interpret numerical data in graphical form.		
3. Functions	a. draw, sketch and recognise graphs of simple cubic functions, the reciprocal function $y = 1/x$ with $x \neq 0$, the function $y = k^x$ for integer values of x and simple positive values of k , and the trigonometric functions $y = \sin x$, $y = \cos x$, and $\tan x$;	HC8.4	A6.4, A8.5, A10.4, A10.5
	b. construct the graphs of simple loci;	HC8.1	
	c. sketch simple transformations of a given function;	HC8.5	
	d. understand and use the Cartesian equation of a circle centred at the origin and link to the trigonometric functions.		

H2L Pythagoras in 2D and 3D			
1. Use Pythagoras' theorem	a. understand, recall and use Pythagoras' theorem to solve simple cases in 2D;	HA13.1, HC11.1	S7.3, S9.2, S10.3
	b. use Pythagoras' theorem to solve more complex cases in 2D;	HA13.1, HC11.1	
	c. use Pythagoras' theorem to calculate lengths in three dimensions;	HA13.1, HC11.1	
	d. use Pythagoras theorem in 3D contexts.	HA13.1, HC11.1	
H2M Angles and properties of shapes			
1. Lines and angles	a. distinguish between lines and line segments;	HB9.1	S4.2, S6.1, S7.2
	b. use parallel lines, alternate angles and corresponding angles;	HB9.1	
	c. understand the consequent properties of parallel and intersecting lines, triangles (including a proof that the angle sum of a triangle is 180°) and parallelograms;	HB9.1	
	d. understand a proof that an exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices.	HB9.1	
2. Congruence and similarity	a. understand congruence;	HB10.1	S6.8, S8.4
	b. understand similarity of plane figures including the relationship between lengths, areas and volumes.	HB10.1	
3. Angles and polygons	a. calculate and use the sums of the interior and exterior angles of polygons;	HB9.3	S6.1
	b. calculate and use the angles of regular polygons;	HB9.3	
	c. solve problems in the context of tiling patterns and tessellations.		

4. Understand and use midpoint and intercept theorems	a. understand and use midpoint and intercept theorems.		
5. Proof	a. understand and construct geometrical proofs using formal arguments, including proving the congruence, or non-congruence, of two triangles in all possible cases.	HB9.1, HB9.4	S9.1, S10.2
H2N Area and Volume			
1. Perimeter, area (including circles), and volume	a. solve problems involving areas;	HC10.1	S1.4, S4.3, S5.4, S6.2, S6.4, S6.5, S7.4, S7.5, S9.3, S10.1
	b. find circumferences of circles and areas enclosed by circles, recalling relevant formulae;	HC10.1	
	c. calculate volumes of right prisms and of shapes made from cubes and cuboids;	HC10.1	
	d. use π in exact calculations;	HC10.1	
	e. calculate volumes of objects made from pyramids, prisms and spheres;	HC10.1	
	f. calculate the lengths of arcs and the areas of sectors of circles;	HC10.1	
	g. solve problems involving more complex shapes and solids, including segments of circles and frustums of cones.	HC10.2	
2. Use 2D representations of 3D shapes	a. use 2D representations of 3D shapes, including plans and elevations.	HC10.2	S3.3, S6.6
H2O Trigonometry			
1. Trigonometry in 2D and 3D	a. understand, recall and use trigonometrical relationships in right-angled triangles, and use these to solve problems, including those involving bearings;	HA12.1	S8.3, S9.2, S10.3
	b. use the trigonometrical ratios to solve 2D and 3D problems;	HC11.1	
	c. use the sine and cosine rules to solve 2D and 3D problems;	HC11.1	
	d. calculate the area of a triangle using $\frac{1}{2}ab\sin C$.	HC11.1	