2.5 Unit A502/02: *Maths Unit B (Higher)*

The content of A502/02 subsumes all the content of A502/01.

This unit will be assessed without the use of a calculator.

HB1 General problem solving skills		**Examples**
These skills should underpin and influence the learning experiences of all candidates in mathematics. They will be assessed within this paper.		
1.1 - Solve problems using mathematical skills	Candidates should be able to: a. select and use suitable problem solving strategies and efficient techniques to solve numerical problems; 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; c. break down a complex calculation into simpler steps before attempting to solve it and justify their choice of methods; d. use notation and symbols correctly and consistently within a problem; 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; f. interpret and discuss numerical information presented in a variety of forms; g. present and interpret solutions in the context of the original problem; h. review and justify their choice of mathematical presentation; i. understand the importance of counter-example and identify exceptional cases when solving problems; j. show step-by-step deduction in solving a problem; 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.	Statements a to k are repeated across all Units

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HB2 Number		
2.1 - Add, subtract, multiply and divide any number	Candidates should be able to: a. derive integer complements to 100; b. recall all multiplication facts to 10×10, and use them to derive quickly the corresponding division facts; c. develop a range of strategies for mental calculation; derive unknown facts from those they know; d. add and subtract mentally numbers with up to two decimal places; e. 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; f. use a variety of methods for addition and subtraction of integers and decimals, understanding where to position the decimal point; g. perform a calculation involving division by a decimal (up to two decimal places) by transforming it to a calculation involving division by an integer.	Statements a and b are repeated in Unit A503
2.2 - Approximate to a specified or appropriate degree of accuracy	Candidates should be able to: a. round to the nearest integer, to any number of decimal places and to one significant figure; b. estimate answers to problems involving decimals; c. estimate and check answers to problems; d. use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude; e. **round to a given number of significant figures;** f. **select, and use, an appropriate degree of accuracy in solving a problem;** g. **develop a range of strategies for mental calculation;** h. **derive unknown facts from those they already know.**	Statement a is repeated from Unit A501 (statement c)

HB3 Fractions, decimals and percentages		
3.1 - Calculate with fractions	Candidates should be able to: a. calculate a given fraction of a given quantity, expressing the answer as a fraction; b. express a given number as a fraction of another; c. add and subtract fractions by writing them with a common denominator; d. perform short division to convert a simple fraction to a decimal; e. multiply and divide a fraction by an integer and by a unit fraction; f. understand and use unit fractions as multiplicative inverses; g. use efficient methods to calculate with fractions, including mixed numbers; h. recognise that, in some cases, only a fraction can express the exact answer; i. 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); j. **multiply and divide a fraction by a general fraction.**	
3.2 - Order rational numbers	Candidates should be able to: a. order integers; b. order fractions by rewriting them with a common denominator; c. order decimals.	
3.3 - Understand equivalent fractions	Candidates should be able to: a. understand equivalent fractions and simplify a fraction by cancelling all common factors.	
3.4 - Use decimal notation	Candidates should be able to: a. use decimal notation and recognise that each terminating decimal is a fraction; b. recognise that recurring decimals are exact fractions; c. know that some exact fractions are recurring decimals; d. **distinguish between fractions with denominators that have only prime factors of 2 and 5 (which are represented by terminating decimals), and other fractions;** e. **convert a recurring decimal to a fraction.**	

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3.5 – Understand percentage	Candidates should be able to: a. understand that 'percentage' means 'number of parts per 100' and use this to compare proportions; b. know the fraction-to-percentage (or decimal) conversion of familiar simple fractions.	
3.6 – Interpret fractions, decimals and percentages as operators	Candidates should be able to: a. interpret percentage as the operator 'so many hundredths of'; b. convert simple fractions of a whole to percentages of the whole, and vice versa; c. understand the multiplicative nature of percentages as operators.	
HB4 Indices and surds		
4.1 - Common index numbers	Candidates should be able to: a. use the terms 'square', 'positive square root', 'negative square root', 'cube' and 'cube root'; b. recall integer squares from 11×11 to 15×15 and the corresponding square roots; c. recall the cubes of 2, 3, 4, 5 and 10.	
4.2 - Use index notation	Candidates should be able to: a. use index notation for squares, cubes and powers of 10; b. use index notation for simple integer powers; c. use index laws for multiplication and division of integer powers; d. use index laws to simplify, and calculate the value of, numerical expressions involving multiplication and division of integer powers; 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 $\frac{1}{n}$;** f. **know that $n^{-1} = \frac{1}{n}$ (undefined for $n = 0$), and that $n^{½} = \sqrt{n}$ and $n^{⅓} = \sqrt[3]{n}$ for any positive number n;** g. **use index laws to simplify, and calculate the value of, numerical expressions involving multiplication and division of integer, fractional and negative powers.**	
4.3 - Use surds in exact calculations	Candidates should be able to: a. **use surds in exact calculations without a calculator;** b. **rationalise a denominator(1).**	**(1)** $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$

HB5 General algebra and coordinates		
5.1 - Symbols and notation	Candidates should be able to: a. distinguish the different roles played by letter symbols in algebra, using the correct notational conventions for multiplying or dividing by a given number; b. know that letter symbols represent definite unknown numbers in equations(1), defined quantities or variables in formulae, general, unspecified and independent numbers in identities(2); c. know that in functions, letter symbols define new expressions or quantities by referring to known quantities(3).	These statements are repeated across all Units These examples relate specifically to Higher tier: **(1) $x^2 + 1 = 82$** **(2) $(x + 1)^2 \equiv x^2 + 2x + 1$ for all values of x** **(3) $y = 2 - 7x$; $y = \frac{1}{x}$ with $x \neq 0$** **f(x) notation may be used**
5.2 - Algebraic terminology	Candidates should be able to: a. distinguish in meaning between the words 'equation', 'formula' and 'expression'; b. **know the meaning of and use the words 'equation', 'formula', 'identity' and 'expression'.**	
5.3 - Use the conventions for coordinates in the plane	Candidates should be able to: a. use the conventions for coordinates in the plane; plot points in all four quadrants; 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'; c. use axes and coordinates to specify points in all four quadrants; d. locate points with given coordinates.	These points occur across all three Units, where an understanding of coordinates is needed to complete other sections of the work 3D is not included in Unit A502
HB6 Functions and graphs		
6.1 - Functions from real life	Candidates should be able to: a. construct linear functions from real life problems and plot their corresponding graphs; b. discuss and interpret linear graphs modelling real situations; c. draw a line of best fit through a set of linearly-related points.	Linear functions only required. These may intersect. Other real life functions are dealt with in Unit A503

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6.2 - Set up and solve simple equations including simultaneous equations in two unknowns	Candidates should be able to: a. 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; b. **solve exactly, by elimination of an unknown, two simultaneous equations in two unknowns, both of which are linear in each unknown.**	
6.3 - Recognise and plot equations that correspond to straight-line graphs in the coordinate plane, including finding gradients	Candidates should be able to: 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; 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(1); c. plot graphs of functions in which y is given explicitly in terms of x, or implicitly, where no table or axes are given.	(1) know that the lines represented by $y = 5x$ and $y = 3 + 5x$ are parallel, each having gradient 5
6.4 - Straight-line graphs and the equation $y = mx + c$	Candidates should be able to: a. **understand that the form $y = mx + c$ represents a straight line and that m is the gradient of the line and c is the value of the y-intercept;** b. **explore the gradients of parallel lines(1) and lines perpendicular to each other(2).**	**(1) know that the lines represented by the equations $y = -5x$ and $y = 3 - 5x$ are parallel, each having gradient (–5)** **(2) know that the line with equation $y = \frac{x}{5}$ is perpendicular to these lines and has gradient $\frac{1}{5}$**

HB7 Inequalities		
7.1 - Solve linear inequalities in one **or two** variables	Candidates should be able to: a. solve simple linear inequalities in one variable, and represent the solution set on a number line; b. **solve several linear inequalities in two variables, represent the inequalities on a suitable diagram, and find the solution set.**	
HB8 General measures		
8.1 - Interpret scales and use measurements	Candidates should be able to: a. interpret scales on a range of measuring instruments, including those for time and mass; b. convert measurements from one unit to another.	These two statements are repeated from Unit A501
HB9 Angles and properties of shapes		
9.1 - Lines and angles	Candidates should be able to: a. recall and use properties of angles at a point, angles at a point on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex; b. distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees; c. distinguish between lines and line segments; d. use parallel lines, alternate angles and corresponding angles; e. understand the consequent properties of parallelograms and a proof that the angle sum of a triangle is 180°; f. understand a proof that an exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices.	
9.2 - Properties of shapes	Candidates should be able to: a. use angle properties of triangles; b. explain why the angle sum of a quadrilateral is 360°; c. recall the essential properties and definitions of special types of quadrilateral, including square, rectangle, parallelogram, trapezium and rhombus; d. classify quadrilaterals by their geometric properties; e. recall the definition of a circle and the meaning of related terms, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment; f. understand that inscribed regular polygons can be constructed by equal division of a circle.	

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9.3 - Angles and polygons	Candidates should be able to: a. calculate and use the sums of the interior and exterior angles of quadrilaterals, pentagons and hexagons; b. calculate and use the angles of regular polygons.	
9.4 - Proofs and circle theorems	Candidates should be able to: a. **understand and use the fact that the tangent at any point on a circle is perpendicular to the radius at that point;** b. **understand and use the fact that tangents meeting at an external point are equal in length;** c. **explain why the perpendicular from the centre to a chord bisects that chord;** 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;** ii. **the angle subtended at the circumference in a semicircle is a right angle;** iii. **angles in the same segment are equal;** iv. **the alternate segment theorem;** v. **opposite angles of a cyclic quadrilateral sum to 180°.**	
HB10 Transformations		
10.1 - Congruence and similarity	Candidates should be able to: a. understand congruence; b. understand similarity of plane figures.	

10.2 - Transform 2D shapes	Candidates should be able to: a. recognise and visualise rotations, reflections and translations, including reflection symmetry of 2D and 3D shapes, and rotation symmetry of 2D shapes; b. understand that rotations are specified by a centre and an (anticlockwise) angle; 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 $y = -x$; d. understand that translations are specified by a column vector; e. transform triangles and other 2D shapes by translation, rotation and reflection and by combinations of these transformations; f. recognise that these transformations preserve length and angle, and hence that any figure is congruent to its image under any of these transformations; g. understand that enlargements are specified by a centre and positive scale factor; h. recognise, visualise and construct enlargements of shapes using positive scale factors greater than one at first, then positive scale factors less than one, **then use positive fractional and negative scale factors**; i. understand from this that any two circles and any two squares are mathematically similar, while, in general, two rectangles are not; j. distinguish properties that are preserved under particular transformations.	
HB11 Vectors		
11.1 - Use vectors	Candidates should be able to: a. **understand and use vector notation;** b. **calculate and represent graphically the sum of two vectors, the difference of two vectors and a scalar multiple of a vector;** c. **calculate the resultant of two vectors;** d. **understand and use the commutative and associative properties of vector addition;** e. **solve simple geometrical problems in 2D using vector methods.**	

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HB12 Bivariate data		
12.1 - Use charts and correlation	Candidates should be able to: a. draw and interpret scatter graphs; b. appreciate that correlation is a measure of the strength of the association between two variables; c. distinguish between positive, negative and zero correlation using lines of best fit; d. appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'; e. draw lines of best fit by eye and understand what these represent; f. draw line graphs for time series; g. interpret time series.	