3. Syllabus content at a glance

All candidates will study the following themes or topics:

Theme or topic	Theme or topic
1. Number	22. Sequences
2. Set language and notation	23. Variation
3. Squares, square roots, cubes and cube roots	24. Graphs in practical situations
4. Directed numbers	25. Graphs of functions
5. Vulgar and decimal fractions and percentages	26. Function notation
6. Ordering	27. Coordinate geometry
7. Standard form	28. Geometrical terms
8. The four operations	29. Geometrical constructions
9. Estimation	30. Similarity and congruence
10. Limits of accuracy	31. Symmetry
11. Ratio, proportion, rate	32. Angles
12. Percentages	33. Loci
13. Use of an electronic calculator	34. Measures
14. Time	35. Mensuration
15. Money	36. Trigonometry
16. Personal and small business finance	37. Vectors in two dimensions
17. Algebraic representation and formulae	38. Matrices
18. Algebraic manipulation	39. Transformations
19. Indices	40. Probability
20. Solutions of equations and inequalities	41. Categorical, numerical and grouped data
21. Graphical representation of inequalities	42. Statistical diagrams

6. Syllabus content

Theme or topic	Subject content	Notes/examples
1. Number	*Candidates should be able to:* • identify and use natural numbers, integers (positive, negative and zero), prime numbers, square numbers, cube numbers, common factors and common multiples, rational and irrational numbers (e.g. π, $\sqrt{2}$), real numbers	Includes expressing numbers as a product of prime factors, finding the Lowest Common Multiple (LCM) and Highest Common Factor (HCF) of two or more numbers.
2. Set language and notation	• use language, notation and Venn diagrams to describe sets and represent relationships between sets Definition of sets: e.g. $A = \{x : x \text{ is a natural number}\}$ $B = \{(x, y): y = mx + c\}$ $C = \{x : a \leqslant x \leqslant b\}$ $D = \{a, b, c\ldots\}$	Includes using Venn diagrams to solve problems. Notation: Number of elements in set A — $n(A)$ "… is an element of …" — $\in$ "… is not an element of …" — $\notin$ Complement of set A — A' The empty set — $\varnothing$ Universal set — $\mathscr{E}$ A is a subset of B — $A \subseteq B$ A is a proper subset of B — $A \subset B$ A is not a subset of B — $A \not\subseteq B$ A is not a proper subset of B — $A \not\subset B$ Union of A and B — $A \cup B$ Intersection of A and B — $A \cap B$
3. Squares, square roots, cubes and cube roots	• calculate squares, square roots, cubes and cube roots of numbers	Includes recall of squares and their corresponding roots from 1 to 15 and cubes and their corresponding roots from 1 to 10.
4. Directed numbers	• use directed numbers in practical situations	e.g. temperature changes or flood levels
5. Vulgar and decimal fractions and percentages	• use the language and notation of simple vulgar and decimal fractions and percentages in appropriate contexts • recognise equivalence and convert between these forms	
6. Ordering	• order quantities by magnitude and demonstrate familiarity with the symbols $=, \neq, >, <, \geqslant, \leqslant$	

Theme or topic	Subject content	Notes/examples
7. Standard form	• use the standard form $A \times 10^n$ where n is a positive or negative integer, and $1 \leqslant A < 10$	Convert numbers into and out of standard form. Calculate with values in standard form.
8. The four operations	• use the four operations for calculations with whole numbers, decimals and vulgar (and mixed) fractions, including correct ordering of operations and use of brackets	
9. Estimation	• make estimates of numbers, quantities and lengths, give approximations to specified numbers of significant figures and decimal places and round off answers to reasonable accuracy in the context of a given problem	e.g. by writing each number correct to one significant figure, estimate the value of $\frac{41.3}{9.79 \times 0.765}$
10. Limits of accuracy	• give appropriate upper and lower bounds for data given to a specified accuracy • obtain appropriate upper and lower bounds to solutions of simple problems given data to a specified accuracy	e.g. measured lengths e.g. the calculation of the perimeter or the area of a rectangle
11. Ratio, proportion, rate	• demonstrate an understanding of ratio and proportion • increase and decrease a quantity by a given ratio • use common measures of rate • solve problems involving average speed	Divide a quantity in a given ratio. Direct and inverse proportion. Use scales in practical situations. Interpreting the ratio as old quantity : new quantity, e.g. decrease $240 in the ratio 5 : 3. e.g. hourly rate of pay or flow rates
12. Percentages	• calculate a given percentage of a quantity • express one quantity as a percentage of another • calculate percentage increase or decrease • carry out calculations involving reverse percentages	e.g. finding the cost price given the selling price and the percentage profit
13. Use of an electronic calculator	• use a calculator efficiently • apply appropriate checks of accuracy • enter a range of measures including 'time' • interpret the calculator display appropriately	e.g. enter 2 hours 30 minutes as 2.5 hours e.g. in money 4.8 means $4.80; in time 3.25 means 3 hours 15 minutes

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14. Time	• calculate times in terms of the 24-hour and 12-hour clock • read clocks, dials and timetables	Includes problems involving time zones.
15. Money	• solve problems involving money and convert from one currency to another	
16. Personal and small business finance	• use given data to solve problems on personal and small business finance involving earnings, simple interest and compound interest • extract data from tables and charts	Includes discount, and profit and loss (as an amount or a percentage). Knowledge of compound interest formula given below is required: Value of investment = $P\left(1+\frac{r}{100}\right)^n$ where P is the amount invested, r is the percentage rate of interest and n is the number of years of compound interest.
17. Algebraic representation and formulae	• use letters to express generalised numbers and express arithmetic processes algebraically • substitute numbers for words and letters in formulae • construct and transform formulae and equations	e.g. transform formulae where the subject appears twice or where a power of the subject appears e.g. construct equations from numerical and geometrical problems.
18. Algebraic manipulation	• manipulate directed numbers • use brackets and extract common factors • expand products of algebraic expressions • factorise where possible expressions of the form: $ax + bx + kay + kby$ $a^2x^2 - b^2y^2$ $a^2 + 2ab + b^2$ $ax^2 + bx + c$ • manipulate algebraic fractions • factorise and simplify rational expressions	e.g. factorise $9x^2 + 15xy$ e.g. expand $3x(2x - 4y)$, $(x + 4)(x - 7)$ e.g. $\frac{x}{3}+\frac{x-4}{2}$, $\frac{2x}{3}-\frac{3(x-5)}{2}$, $\frac{3a}{4}\times\frac{9a}{10}$ $\frac{3a}{4}\div\frac{9a}{10}$, $\frac{1}{x-2}+\frac{2}{x-3}$ e.g. $\frac{x^2-2x}{x^2-5x+6}$

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19. Indices	• understand and use the rules of indices	e.g. work out $2^{-3} \times 2^4$ e.g. simplify $3x^{-4} \times \frac{2}{3}x^{\frac{1}{2}}$, $\frac{2}{5}x^{\frac{1}{2}} \div 2x^{-2}$ and $\left(\frac{2x^5}{3}\right)^3$
	• use and interpret positive, negative, fractional and zero indices	e.g. $5^{\frac{1}{2}} = \sqrt{5}$ e.g. evaluate 2^5, 4^0, 5^{-2}, $100^{\frac{1}{2}}$, $8^{-\frac{2}{3}}$ e.g. solve $32^x = 2$
20. Solutions of equations and inequalities	• solve simple linear equations in one unknown • solve fractional equations with numerical and linear algebraic denominators • solve simultaneous linear equations in two unknowns • solve quadratic equations by factorisation, completing the square or by use of the formula • solve simple linear inequalities	Includes writing a quadratic expression in completed square form.
21. Graphical representation of inequalities	• represent linear inequalities graphically	Linear programming problems are not included.
22. Sequences	• continue a given number sequence • recognise patterns in sequences and relationships between different sequences • generalise sequences as simple algebraic statements	Includes linear sequences, quadratic and cubic sequences, exponential sequences and simple combinations of these. Including expressions for the *n*th term.
23. Variation	• express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities	Includes linear, square, square root and cubic variation (direct and inverse). e.g. y is inversely proportional to the square of x. Given that $y = 2$ when $x = 6$, find the value of y when $x = 2$
24. Graphs in practical situations	• interpret and use graphs in practical situations including travel graphs and conversion graphs • draw graphs from given data • apply the idea of rate of change to easy kinematics involving distance–time and speed–time graphs, acceleration and deceleration • calculate distance travelled as area under a linear speed–time graph	

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25. Graphs of functions	• construct tables of values and draw graphs for functions of the form ax^n where a is a rational constant, and $n = -2, -1, 0, 1, 2, 3$, and simple sums of not more than three of these and for functions of the form ka^x where a is a positive integer • interpret graphs of linear, quadratic, cubic, reciprocal and exponential functions • solve associated equations approximately by graphical methods • estimate gradients of curves by drawing tangents	
26. Function notation	• use function notation, e.g. $f(x) = 3x - 5$, $f: x \longmapsto 3x - 5$, to describe simple functions • find inverse functions $f^{-1}(x)$	
27. Coordinate geometry	• demonstrate familiarity with Cartesian coordinates in two dimensions • find the gradient of a straight line • calculate the gradient of a straight line from the coordinates of two points on it • calculate the length and the coordinates of the midpoint of a line segment from the coordinates of its end points • interpret and obtain the equation of a straight line graph in the form $y = mx + c$ • determine the equation of a straight line parallel to a given line • find the gradient of parallel and perpendicular lines	e.g. find the equation of a line parallel to $y = 4x - 1$ that passes through $(0, -3)$ e.g. find the gradient of a line perpendicular to $y = 3x + 1$ e.g. find the equation of a line perpendicular to one passing through the coordinates $(1, 3)$ and $(-2, -9)$

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28. Geometrical terms	• use and interpret the geometrical terms: point; line; plane; parallel; perpendicular; bearing; right angle, acute, obtuse and reflex angles; interior and exterior angles; similarity and congruence • use and interpret vocabulary of triangles, special quadrilaterals, circles, polygons and simple solid figures • understand and use the terms: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment	Includes the following terms: Triangles: equilateral, isosceles and scalene (including right-angled triangles). Quadrilaterals: square, rectangle, kite, rhombus, parallelogram, trapezium. Polygons: Regular and irregular polygons; pentagon, hexagon, octagon, decagon. Simple solid figures: cube, cuboid, prism, cylinder, pyramid, cone, sphere; face, surface, edge, vertex and net.
29. Geometrical constructions	• measure lines and angles • construct a triangle, given the three sides, using a ruler and pair of compasses only • construct other simple geometrical figures from given data, using a ruler and protractor as necessary • construct angle bisectors and perpendicular bisectors using a pair of compasses as necessary • read and make scale drawings • use and interpret nets	
30. Similarity and congruence	• solve problems and give simple explanations involving similarity and congruence • calculate lengths of similar figures • use the relationships between areas of similar triangles, with corresponding results for similar figures, and extension to volumes and surface areas of similar solids	Includes showing that two triangles are similar or showing that two triangles are congruent (using correct congruence condition SSS, SAS, ASA, RHS). Includes use of scale factor.

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31. Symmetry	• recognise rotational and line symmetry (including order of rotational symmetry) in two dimensions • recognise symmetry properties of the prism (including cylinder) and the pyramid (including cone) • use the following symmetry properties of circles: (a) equal chords are equidistant from the centre (b) the perpendicular bisector of a chord passes through the centre (c) tangents from an external point are equal in length	Includes properties of triangles, quadrilaterals and circles directly related to their symmetries.
32. Angles	• calculate unknown angles and give simple explanations using the following geometrical properties: (a) angles at a point (b) angles at a point on a straight line and intersecting straight lines (c) angles formed within parallel lines (d) angle properties of triangles and quadrilaterals (e) angle properties of regular and irregular polygons (f) angle in a semi-circle (g) angle between tangent and radius of a circle (h) angle at the centre of a circle is twice the angle at the circumference (i) angles in the same segment are equal (j) angles in opposite segments are supplementary	Candidates will be expected to use the correct geometrical terminology when giving reasons for answers. Angle properties of polygons includes angle sum.

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33. Loci	• use the following loci and the method of intersecting loci for sets of points in two dimensions which are: (a) at a given distance from a given point (b) at a given distance from a given straight line (c) equidistant from two given points (d) equidistant from two given intersecting straight lines	
34. Measures	• use current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units	Convert between units including units of area and volume. e.g. between mm^2 and cm^2 or between cm^3, m^3 and litres
35. Mensuration	• solve problems involving: (a) the perimeter and area of a rectangle and triangle (b) the perimeter and area of a parallelogram and a trapezium (c) the circumference and area of a circle (d) arc length and sector area as fractions of the circumference and area of a circle (e) the surface area and volume of a cuboid, cylinder, prism, sphere, pyramid and cone (f) the areas and volumes of compound shapes	Formulae will be given for the surface area and volume of the sphere, pyramid and cone.

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36. Trigonometry	• interpret and use three-figure bearings	Measured clockwise from the north, i.e. 000°–360°. e.g. Find the bearing of A from B if the bearing of B from A is 125°
	• apply Pythagoras' theorem and the sine, cosine and tangent ratios for acute angles to the calculation of a side or of an angle of a right-angled triangle	Angles will be quoted in, and answers required in, degrees and decimals of a degree to one decimal place.
	• solve trigonometrical problems in two dimensions involving angles of elevation and depression	
	• extend sine and cosine functions to angles between 90° and 180°	
	• solve problems using the sine and cosine rules for any triangle and the formula area of triangle = $\frac{1}{2}ab\sin C$	
	• solve simple trigonometrical problems in three dimensions	Calculations of the angle between two planes or of the angle between a straight line and plane will not be required.
37. Vectors in two dimensions	• describe a translation by using a vector represented by $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$ or **a**	Vectors will be printed as $\overrightarrow{AB}$ or **a** and their magnitudes denoted by modulus signs, e.g. $\lvert\overrightarrow{AB}\rvert$ or $\lvert\mathbf{a}\rvert$.
	• add and subtract vectors	In their answers to questions candidates are expected to indicate **a** in some definite way, e.g. by an arrow $\overrightarrow{AB}$ or by underlining as follows a.
	• multiply a vector by a scalar	
	• calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2+y^2}$	
	• represent vectors by directed line segments	
	• use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors	
	• use position vectors	

Theme or topic	Subject content	Notes/examples
38. Matrices	• display information in the form of a matrix of any order • solve problems involving the calculation of the sum and product (where appropriate) of two matrices, and interpret the results • calculate the product of a matrix and a scalar quantity • use the algebra of 2 × 2 matrices including the zero and identity 2 × 2 matrices • calculate the determinant $\lvert\mathbf{A}\rvert$ and inverse $\mathbf{A}^{-1}$ of a non-singular matrix **A**	
39. Transformations	• use the following transformations of the plane: reflection (M), rotation (R), translation (T), enlargement (E) and their combinations • identify and give precise descriptions of transformations connecting given figures • describe transformations using coordinates and matrices	If M(a) = b and R(b) = c the notation RM(a) = c will be used. Invariants under these transformations may be assumed. Singular matrices are excluded.
40. Probability	• calculate the probability of a single event as either a fraction or a decimal • understand that the probability of an event occurring = 1 – the probability of the event not occurring • understand relative frequency as an estimate of probability • calculate the probability of simple combined events using possibility diagrams and tree diagrams where appropriate	Probabilities should not be given as ratios. Problems could be set involving extracting information from tables or graphs. e.g. P(blue) = 0.8, find P(not blue) e.g. use results of experiments with a spinner to estimate the probability of a given outcome e.g. use probability to estimate from a population In possibility diagrams outcomes will be represented by points on a grid and in tree diagrams outcomes will be written at the end of branches and probabilities by the side of the branches.

Theme or topic	Subject content	Notes/examples
41. Categorical, numerical and grouped data	• collect, classify and tabulate statistical data • read, interpret and draw simple inferences from tables and statistical diagrams • calculate the mean, median, mode and range for individual and discrete data and distinguish between the purposes for which they are used • calculate an estimate of the mean for grouped and continuous data • identify the modal class from a grouped frequency distribution	
42. Statistical diagrams	• construct and interpret bar charts, pie charts, pictograms, simple frequency distributions, frequency polygons, histograms with equal and unequal intervals and scatter diagrams • construct and use cumulative frequency diagrams • estimate and interpret the median, percentiles, quartiles and interquartile range for cumulative frequency diagrams • calculate with frequency density • understand what is meant by positive, negative and zero correlation with reference to a scatter diagram • draw a straight line of best fit by eye.	For unequal intervals on histograms, areas are proportional to frequencies and the vertical axis is labelled 'Frequency density'.