

## Mathematics scope and sequence chart: Grades 10 to 12 foundation

	Grade 10	Grade 11	Grade 12
<b>REASONING AND PROBLEM SOLVING</b>			
<b>To be applied to all strands</b>	<ul style="list-style-type: none"> <li>Routine and non-routine problem solving</li> <li>Modelling real-world applications</li> <li>Identifying and using connections between mathematical topics</li> <li>Breaking complex problems into smaller tasks; using problem solving strategies to set up and solve relevant equations and to perform appropriate calculations</li> <li>Developing and explaining short chains of reasoning, using correct notation and terms; generalising; generating mathematical proofs; identifying exceptional cases</li> <li>Solving problems systematically; conjecturing possibilities; synthesising, presenting, interpreting and criticising mathematical information; working to expected degrees of accuracy</li> <li>Recognising when to use ICT; using ICT efficiently</li> </ul>	<ul style="list-style-type: none"> <li>Routine and non-routine problem solving</li> <li>Modelling real-world applications</li> <li>Identifying and using connections between mathematical topics</li> <li>Breaking complex problems into smaller tasks; using problem solving strategies to set up and solve relevant equations and to perform appropriate calculations</li> <li>Developing and explaining chains of reasoning, using correct notation and terms; generalising; generating mathematical proofs; identifying exceptional cases</li> <li>Solving problems systematically; conjecturing possibilities; synthesising, presenting, interpreting and criticising mathematical information; working to expected degrees of accuracy</li> <li>Recognising when to use ICT; using ICT efficiently</li> </ul>	<ul style="list-style-type: none"> <li>Routine and non-routine problem solving</li> <li>Modelling real-world applications</li> <li>Identifying and using connections between mathematical topics</li> <li>Breaking complex problems into smaller tasks; using problem solving strategies to set up and solve relevant equations and to perform appropriate calculations</li> <li>Developing and explaining longer chains of reasoning, using correct notation and terms; generalising; generating mathematical proofs; discussing exceptional cases</li> <li>Solving problems systematically; conjecturing possibilities; synthesising, presenting, interpreting and criticising mathematical information; working to expected degrees of accuracy</li> <li>Recognising when to use ICT; using ICT efficiently</li> </ul>
<b>NUMBER AND ALGEBRA</b>			
<b>General</b>	<ul style="list-style-type: none"> <li>Real-world numerical and algebraic applications</li> <li>Linking algebraic reasoning to geometrical ideas</li> <li>Contributions to mathematics by Islamic scholars</li> </ul>	<ul style="list-style-type: none"> <li>Real-world numerical and algebraic applications</li> <li>Contributions to mathematics by Islamic scholars</li> </ul>	<ul style="list-style-type: none"> <li>Real-world numerical and algebraic applications</li> <li>Contributions to mathematics by Islamic scholars</li> </ul>
<b>Number</b>	<ul style="list-style-type: none"> <li>Powers, <math>n</math>th roots; exact calculations with surds; standard form</li> <li>Calculations with any real numbers, including mental calculations; multiplicative nature of proportional reasoning; using, forming, simplifying and comparing ratios; percentage calculations, including percentage of a percentage, inverse percentage</li> </ul>	<ul style="list-style-type: none"> <li>Compound interest problems; limiting value of compounding interest more and more frequently</li> </ul>	
<b>Set theory</b>	<ul style="list-style-type: none"> <li>The number sets: <math>\mathbb{R}</math> (reals), <math>\mathbb{Z}</math> (integers), <math>\mathbb{N}</math> (natural numbers), <math>\mathbb{Q}</math> (rationals); irrational numbers</li> <li>Common set theory symbols: <math>\mathcal{E}</math> (universal set), <math>\emptyset</math> (null set), <math>\in</math> (is a member of), <math>\notin</math> (is not a member of), <math>\forall</math> (for all), brace notation; <math>A \cup B</math> (union of sets); <math>A \cap B</math> (intersection of sets); <math>A'</math> (complement of set <math>A</math>); <math>A \cup A' = \mathcal{E}</math>; further Venn diagrams</li> </ul>		

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<b>Sequences, functions and graphs</b>	<ul style="list-style-type: none"> <li>Algebraic generalisations for odd and even numbers; vocabulary related to primes, factors, multiples, divisors</li> <li>Sequences from term-to-term and position-to-term definitions; simple growth patterns; Pascal's triangle; arithmetic sequences; sum of first <math>n</math> consecutive integers</li> <li>Function, domain and range; functional relationships between related variables; graphs of simple functional relationships from familiar contexts; recognising when a graph represents a function; function notation <math>y = f(x)</math></li> <li>Translation of 'y is proportional to x' into equation <math>y = kx</math> representing a straight line through the origin, with gradient <math>k</math>; common examples of direct proportion</li> <li>Plotting straight line equations <math>y = mx + c</math>; <math>m</math> as gradient of line and <math>c</math> as intercept on <math>y</math>-axis; establishing Cartesian equations of lines from appropriate information; conditions for two straight lines to be parallel or perpendicular, including special cases</li> <li>Finding point of intersection of two lines: exactly using algebraic methods, approximately using graphical methods; interpreting solutions in physical contexts</li> <li>Quadratic functions of the form <math>y = ax^2 + c</math>; their graphs, intercepts with the coordinate axes, axis of symmetry and coordinates of the maximum or minimum point; modelling with quadratic functions</li> </ul>	<ul style="list-style-type: none"> <li>Geometric sequences and their sums; evaluating any recurring decimal as an exact fraction</li> <li>Further work on straight lines, including implicit form <math>ax + by + c = 0</math></li> <li>Regions of linear inequality; solution of simple problems</li> <li>Further functional relationships between related variables and their graphs</li> <li>Tangent line at a point on the graph of a function, its gradient and its interpretation in physical applications</li> <li>Approximate solutions of <math>ax^2 + bx + c = 0</math> from graph of <math>y = ax^2 + bx + c</math></li> <li>Further quadratic functions <math>y = ax^2 + bx + c</math>; their graphs, intercepts with coordinate axes, axis of symmetry and coordinates of maximum or minimum point; when such functions are increasing, decreasing or stationary; modelling situations with quadratic functions</li> <li>Translation of 'y is proportional to <math>x^2</math>' into equation <math>y = kx^2</math> representing a parabola</li> <li>Translation of 'y is inversely proportional to x' into equation <math>y = k/x</math>, where <math>x \neq 0</math> and <math>x</math>- and <math>y</math>-axes are each asymptotes to the curve; examples of inverse proportionality</li> </ul>	<ul style="list-style-type: none"> <li>Recurrence relations in physical applications</li> <li>Using physical contexts to plot and interpret graphs of linear, quadratic and cubic functions, reciprocal function <math>y = k/x</math> (<math>x \neq 0</math>), sine and cosine functions, modulus function and a range of simple non-standard functions; using a graphics calculator to show approximate solutions to physical problems requiring location and interpretation of intersection points of two or more graphs</li> <li>Inverse functions of simple functions</li> <li>Addition, subtraction, multiplication of two functions; division in simple cases</li> <li>Composite functions and notation <math>y = f(g(x))</math>; deconstruction of composite functions into constituent functions</li> <li>Transformation of <math>y = f(x)</math> to <math>y = f(x) + a</math>, <math>y = f(x - a)</math>, <math>y = af(x)</math>, <math>y = f(ax)</math>, and interpretations as translation in the <math>y</math>-direction, the <math>x</math>-direction, and stretch or compression in the <math>y</math>- and <math>x</math>-direction respectively</li> <li>Exponential growth and decay and associated graphs <math>y = a^x</math>, where <math>a &gt; 0</math>; using graphics calculator to plot graphs of exponential function, <math>e^x</math>, and natural logarithm function, <math>\ln x</math>; solution of equation <math>y = a^x</math> and its use in problems; log function (base 10) on a calculator</li> </ul>
<b>Expressions, equations and formulae</b>	<ul style="list-style-type: none"> <li>Working with symbols; distinguishing expressions, equations, formulae and identities; recognising that rules of algebra generalise the rules of arithmetic</li> <li>Brackets and correct order of precedence of operations when performing numerical or algebraic calculations</li> <li>Combining numeric or algebraic fractions; multiplying combinations of monomial and binomial expressions</li> <li>Simplifying numeric and algebraic fractions; rationalising denominators of fractions containing surds</li> <li>Solving any linear equation with one unknown, and a pair of simultaneous linear equations</li> <li>Rearranging formulae connecting at least two variables</li> </ul>	<ul style="list-style-type: none"> <li>Further working with symbols in expressions, equations, formulae and identities</li> <li>Multiplication of combinations of monomial, binomial and trinomial expressions; linear factors of quadratic expressions; difference of two squares</li> <li>Substitution of an expression into another formula, including a linear into a quadratic expression</li> <li>Exact solutions of quadratic equations by factorisation, by completing the square, by using the quadratic formula</li> <li>Solution set of two simultaneous equations, one linear and one quadratic; physical problems modelled simultaneously by two such functions</li> </ul>	<ul style="list-style-type: none"> <li>Further working with expressions, equations, formulae and identities</li> </ul>
<b>Using ICT</b>	<ul style="list-style-type: none"> <li>Using ICT to explore sequences, functions and graphs</li> </ul>	<ul style="list-style-type: none"> <li>Using ICT to explore sequences, functions and graphs</li> </ul>	<ul style="list-style-type: none"> <li>Using ICT to explore sequences, functions and graphs</li> </ul>

	Grade 10	Grade 11	Grade 12
<b>GEOMETRY AND MEASURES</b>			
<b>General</b>	<ul style="list-style-type: none"> <li>Real-world geometrical applications</li> </ul>	<ul style="list-style-type: none"> <li>Real-world geometrical applications</li> </ul>	<ul style="list-style-type: none"> <li>Real-world geometrical applications</li> </ul>
<b>Using ICT</b>	<ul style="list-style-type: none"> <li>Using dynamic geometry systems (DGS) to explore pattern, similarity, congruence and constructions, and to conjecture geometric properties and theorems</li> </ul>	<ul style="list-style-type: none"> <li>Using dynamic geometry systems (DGS) to explore pattern, similarity, congruence and constructions, and to conjecture geometric properties and theorems</li> </ul>	<ul style="list-style-type: none"> <li>Using dynamic geometry systems (DGS) for further exploration of pattern, similarity, congruence and constructions, including plans and elevations</li> </ul>
<b>Geometry</b>	<ul style="list-style-type: none"> <li>Angles at a point, angles on a straight line, alternate and corresponding angles; formal arguments to establish congruency of two triangles; using congruency of two triangles to generate further knowledge</li> <li>Similarity of two triangles and other rectilinear shapes; preservation of shape and angles, but not of size, in a similarity transformation; ratio of lengths of sides and areas of similar figures; ratio of volume of a scale model to volume of the actual object</li> <li>Regular polygons and their interior and exterior angles</li> <li>Constructions using straight edge and compass</li> <li>Simple loci, including those arising in physical situations</li> </ul>	<ul style="list-style-type: none"> <li>Points of intersection of straight line with circle</li> <li>Relevant vocabulary associated with a circle; proof of standard circle theorems</li> </ul>	<ul style="list-style-type: none"> <li>Transformations of rectilinear figures using combinations of translations, rotations about centre of rotation, enlargements about centre of enlargement, and reflections about a line; positive, negative and fractional scale factors in enlargements; Islamic patterns</li> <li>Maps and scale drawings</li> <li>Plans and elevations</li> </ul>
<b>Trigonometry</b>	<ul style="list-style-type: none"> <li>Solution of triangles using standard trigonometric ratios</li> <li>Proof of Pythagoras' theorem; using Pythagoras' theorem to find the distance between two points, to solve right-angled triangles and to set up the Cartesian equation of a circle of radius <math>r</math>, centred at the origin of an <math>xy</math>-coordinate system</li> </ul>	<ul style="list-style-type: none"> <li>Sine rule and cosine rule; triangle problems in two and three dimensions; area of triangle using <math>\frac{1}{2}ab\sin C</math></li> <li>Using Pythagoras' theorem to find Pythagorean triples; set up the Cartesian equation of a circle of radius <math>r</math>, centred at point <math>(\alpha, \beta)</math>; unit circle <math>x^2 + y^2 = 1</math> and plots of graphs of circular functions <math>\sin \theta</math> and <math>\cos \theta</math> for any angle <math>\theta^\circ</math>, where <math>0^\circ \leq \theta^\circ \leq 360^\circ</math>; the identity <math>\sin^2 \theta^\circ + \cos^2 \theta^\circ \equiv 1</math> for any angle <math>\theta^\circ</math> and simple related identities; simple problems modelled by circular functions</li> </ul>	
<b>Measures and mensuration</b>	<ul style="list-style-type: none"> <li>Perimeters and areas of rectilinear and circular shapes, and volumes of rectilinear solids, cones, cylinders and spheres</li> <li>Bearings</li> <li>SI units</li> <li>Compound measures, including those that reinforce links with science and technology</li> </ul>	<ul style="list-style-type: none"> <li>Radian measure for calculating sector areas and arc lengths</li> <li>Latitude, longitude and great circles and their use in solving problems relating to position, distance and displacement on the Earth's surface</li> <li>Further compound measures, including those that reinforce links with science and technology</li> </ul>	<ul style="list-style-type: none"> <li>Further compound measures, including those that reinforce links with other disciplines, including the social sciences</li> <li>Approximation methods to calculate the area of an irregular two-dimensional flat surface and the volume of a prism with a constant, but irregular-shaped, cross-section</li> </ul>

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<b>Vectors</b>			<ul style="list-style-type: none"> <li>• Vectors: position vector and translation as a vector displacement; knowing that the vector displacement depends only on the starting point and the finish point, and not on intermediate steps</li> <li>• Addition and subtraction of two vectors in up to three dimensions and the corresponding vector diagrams</li> <li>• Scalar product of two vectors; multiplication of a vector by a scalar; magnitude and direction of a vector; vector displacement and velocity; unit vectors and components</li> <li>• Solution of physical problems using vectors</li> </ul>
<b>PROBABILITY AND STATISTICS</b>			
<b>Probability and statistics</b>	<ul style="list-style-type: none"> <li>• Using statistical data collected from samples to make inferences about the population as a whole</li> <li>• Distinguishing qualitative from quantitative data, and discrete from continuous data</li> <li>• Measures of central tendency</li> <li>• Simple histograms</li> <li>• Scatter diagrams between two random variables associated with common contexts; elementary qualitative discussion of correlation, including positive and negative correlation; drawing a line of best fit by eye through the scatter points when there appears to be some correlation</li> </ul>	<ul style="list-style-type: none"> <li>• Representative samples; random and biased samples; location of sources of bias</li> <li>• Planning surveys and questionnaires to collect meaningful primary data from samples to make estimates of, or test hypotheses about, quantities or attributes characteristic of the population as a whole</li> <li>• Using secondary data from published sources, including the Internet</li> <li>• Measures of central tendency</li> <li>• Histograms, frequency and (relative) frequency distributions and associated distributions; using grouped continuous data</li> <li>• Stem-and-leaf diagrams and box-and-whisker plots; making inferences and drawing conclusions from analysis of data in a range of situations</li> </ul>	<ul style="list-style-type: none"> <li>• Random variables</li> <li>• Empirical probability (relative frequency) of a particular value; using simple mathematical models to calculate theoretical probability of particular outcome for a random variable; knowing that probability values lie between 0 and 1</li> <li>• Risk as probability of occurrence of an adverse event; risk in everyday situations</li> <li>• Sum of probabilities for all outcomes of mutually exclusive and exhaustive events is 1; when two events A and B are mutually exclusive, probability of A or B, <math>P(A \cup B)</math>, is <math>P(A) + P(B)</math>; two events A and B are independent if the probability of A and B occurring together, <math>P(A \cap B)</math>, is <math>P(A) \times P(B)</math></li> <li>• Tree diagrams for representing and calculating the probabilities of compound events when events are independent or when one is conditional on another</li> <li>• Measures of spread</li> <li>• Trends over time and moving averages</li> <li>• Simulation using random numbers to model simple situations, including waiting times</li> </ul>
<b>Using ICT</b>	<ul style="list-style-type: none"> <li>• Using a calculator with statistical functions for analysing large data sets</li> <li>• Using ICT packages to produce statistical tables and graphs</li> </ul>	<ul style="list-style-type: none"> <li>• Using a calculator with statistical functions for analysing large data sets</li> <li>• Using ICT packages to produce statistical tables and graphs</li> </ul>	<ul style="list-style-type: none"> <li>• Using a calculator with statistical functions for analysing large data sets</li> <li>• Using ICT packages to produce statistical tables and graphs</li> </ul>