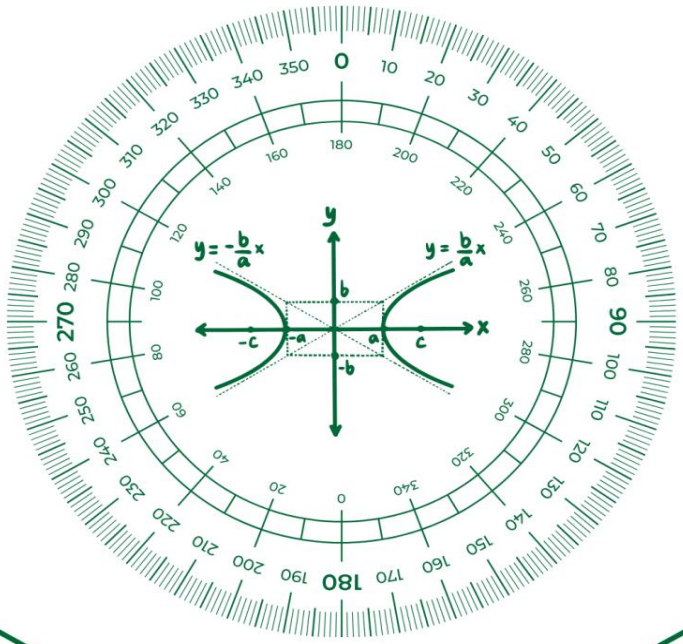
ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

SSC A
Mathematics Syllabus



For exams in 2026 & onwards

INTRODUCTION TO ZUEB

The Ziauddin University Examination Board (ZUEB) is not only an awarding body but also a solution-driven educational organization dedicated to upholding the highest standards of academic excellence. ZUEB believes in Excellence, Integrity, and Innovation in Education. Established with a vision to foster a robust educational environment, ZUEB is committed to nurturing intellectual growth and development that meets international standards in an effective manner. The Ziauddin University Examination Board (ZUEB) was established through Government Gazette No. XLI on June 6th, 2018. Its purpose is to ensure a high quality, maintain global standards, and align the syllibi with national integrity within the examination system of Pakistan. ZUEB manages student appeals, regulates assessments, and reviews policies to maintain high standards.

WHY CHOOSE SSC-A AT ZUEB?

Ziauddin University Examination Board (ZUEB) offers the SSC-A (Secondary School Certificate advance) program, designed for students from international educational backgrounds. This program provides a structured, affordable, and academically strong pathway for learners to align with Pakistan's education system. It allows students to fulfil national curriculum requirements, including Urdu, Islamiyat, Pakistan Studies, or Sindhi, with academic integrity and flexible learning options. ZUEB believes no student should be left behind due to financial limitations or cross-system transitions, and SSC-A serves as a bridge between past efforts and future ambitions. It is the trusted choice for higher education in Pakistan.

SSC-ADVANCE MATHEMATICS

Mathematics in the SSC-advance qualification at ZUEB is a vital subject for students aspiring to excel in engineering, computer science, economics, and applied sciences. It develops essential skills in logical reasoning, abstract thinking, and quantitative problem-solving, which are critical for academic achievement and professional growth. By nurturing creativity in approaching mathematical challenges, the course equips learners with the intellectual tools required to succeed in both national and international examinations.

Aligned with national curriculum standards while also reflecting global academic expectations, SSC-A Mathematics offers a balanced and rigorous learning experience. Students engage with key areas such as algebra, geometry, trigonometry, calculus, probability, and statistics, delivered through a structured and supportive learning model that emphasizes both practice and application.

Whether your goal is to pursue engineering, data science, economics, or advance scientific research, SSC-A Mathematics provides a strong foundation to ensure you are academically prepared, nationally aligned, and globally competitive. Explore more on what SSC-A offers: ZUEB SSC-A Official Page.

Syllabus Overview			
No.	**Content**	**AO**	**Exam**
1	The Language of Mathematics	1,2,3	Combination of written exam papers (externally set and marked) **Paper 1:** Short Answer Questions Duration: 1 hour 50 minutes **Paper 2:** Structured Questions Duration: 2 hours 10 minutes
2	Algebra	1,2,3	
3	Graphs	1,2,3	
4	Geometry	1,2,3	
5	Mensuration and Vectors	1,2,3	
6	Probability and Statistics	1,2,3	

Description of Assessment Objectives

AO1 – Show knowledge and understanding of:

- scientific concepts and principles
- relevant methods, techniques, and procedures

AO2 – Apply knowledge and understanding to:

- use scientific ideas in various contexts
- perform and explain investigations, techniques, and procedures

AO3 – Analyse and interpret to:

- evaluate information and data
- draw reasoned conclusions and judgements
- suggest improvements to experimental methods

Weighting of Assessment Objectives

Assessment Objectives	P1 (%)	P2 (%)
A01	30	30
A02	40	40
A03	30	30

The Language of Mathematics				
Aim: To introduce the foundational language that underpins most of mathematics.				
	The learner will:	**SLO #**	**Assessment Criteria - The learner can:**	**Cognitive levels**
1	Understand integers, decimals and fractions.	1.1.1	**Know** and **understand** what an 'Integer' is, that they can be positive, negative or zero, and that they can be 'Odd' or 'Even'.	AO1
		1.1.2	**Identify** place values in integers and **use** them to interpret or construct numbers in expanded or positional form.	AO2
		1.1.3	**Use** a number line to place and order integers (positive, negative, and zero) in increasing or decreasing value.	AO2
		1.1.4	**Use** and **interpret** relational symbols (=, ≠, <, >) and **describe** them in words (e.g., equal to, less than).	AO2
		1.1.5	**Define** and **distinguish** between proper fractions, improper fractions, and mixed numbers. (understanding proper and improper fractions is crucial for understanding mixed numbers)	AO1
		1.1.6	**Know** and **Use** standard mathematical notation to represent fractions and mixed numbers accurately.	AO2
		1.1.7	**Know** and **identify** the numerator and denominator of a fraction.	AO1
		1.1.8	**Know** and **Understand** the concept of equivalent fractions as having equal values despite different forms.	AO1
		1.1.9	**Order** a set of equivalent or unlike fractions by finding common denominators or using benchmarks on a number line.	AO3
2	Understand how to add, subtract, multiply and divide.	1.2.1	**Know** and **Understand** how to add, subtract, multiply, and divide positive and negative integers using written and mental strategies.	AO2
		1.2.2	**Define** and **apply** the terms 'product' and 'reciprocal' in arithmetic and algebraic contexts.	AO2
		1.2.3	**Recognize** that an operation is a mathematical process and **describe** examples of the four basic operations.	AO1
		1.2.4	**Perform** addition, subtraction, multiplication, and division with large whole numbers without the use of a calculator.	AO2
		1.2.5	**Know** and **use** 'inverse operation' and **explain** how it can be used to check or reverse a calculation.	AO2
		1.2.6	**Know** and **use** that addition and subtraction are inverse operations, and that multiplication and division are inverse operations.	AO2
3	Understand prime numbers	1.3.1	**Know** and **Understand** a prime number as an integer greater than 1 that has no positive factors other than 1 and itself.	AO1
		1.3.2	**Recall** and **use** the first six prime numbers (2, 3, 5, 7, 11, 13) in factorisation and divisibility tasks.	AO2
		1.3.3	**Know** and **Understand** that multiple of a number as the product of that number with an integer greater than 1.	AO1
		1.3.4	**Know** and **Understand** factors (or divisors) of a given integer.	AO1
		1.3.5	**Know** and **use** the Unique Prime Factorisation Theorem and its significance in number theory.	AO2
		1.3.6	**Express** integers as products of prime numbers, including exponential form.	AO2
		1.3.7	**Identify** and **determine** the Lowest Common Multiple (LCM) of two or more integers.	AO2
		1.3.8	**Identify** and **determine** the Highest Common Factor (HCF) of two or more integers.	AO2
		1.3.9	**Use** common factors and common multiples to simplify fractions and solve numerical problems.	AO3

4	Understand powers and roots.	1.4.1	**Know** and **understand** that a power represents repeated multiplication, and **explain** that squaring and cubing are powers of 2 and 3, respectively.	AO1
		1.4.2	**Represent** powers using indices notation (e.g., 2^3) and **understand** exponential form.	AO2
		1.4.3	**Calculate** the values of positive integer powers of numbers.	AO2
		1.4.4	**Know** and **understand** roots as inverse operations of powers, and **distinguish** between square roots and cube roots.	AO1
		1.4.5	**Express** roots using both root (√) notation and fractional indices (e.g., N^(1/2) or N^(1/3).	AO2
		1.4.6	**Calculate** square and cube roots of numbers using exact or approximate methods.	AO2
		1.4.7	**Demonstrate** the inverse relationship between powers and roots (e.g., $\sqrt{N^2} = N$).	AO2
		1.4.8	**Know** and **understand** that not all roots result in integers and **define** a surd as an irrational root that cannot be simplified.	AO2
		1.4.9	**Simplify** numerical expressions involving square roots (e.g., $\sqrt{50} = 5\sqrt{2}$).	AO1
		1.4.10	**Express** results in exact form using fractions, surds, or powers of π unless approximation is required.	AO2
		1.4.11	**Know** and **use** the fact that the order of mathematical operations is clearly defined so that there is only one correct way of interpreting a sequence of written operations.	AO3
5	Understand fractions and ratios.	1.5.1	**Know** and **understand** that a vulgar (common) fraction is a fraction in which both the numerator and denominator are integers.	AO1
		1.5.2	**Distinguish** between proper and improper fractions based on their numerical value.	AO1
		1.5.3	**Know** and **understand** complex fractions as those in which the numerator and/or the denominator is itself a fraction.	AO1
		1.5.4	**Simplify** complex fractions, including through the division of fractions.	AO2
		1.5.5	**Know** and **understand** how to multiply proper, improper, and mixed fractions accurately.	AO2
		1.5.6	**Know** and **use** a fraction as a multiplicative inverse to solve problems.	AO2
		1.5.7	**Simplify** fractions by identifying and cancelling common factors in the numerator and denominator.	AO2
		1.5.8	**Identify** common multiples in denominators and **use** them to add or subtract fractions.	AO2
		1.5.9	**Know** and **understand** what a common denominator is, and **explain** its use in fraction operations.	AO1
		1.5.10	**Simplify** algebraic fractions where surds or powers appear in the numerator or denominator.	AO2
		1.5.11	**Know** and **understand** that a ratio is a comparison of two or more quantities and represent it using colon notation (a:b).	AO1
		1.5.12	**Identify** common multiples in denominators and **use** them to add or subtract fractions.	AO2
		1.5.13	**Know** and **understand** how ratios can be represented as fractions and vice versa.	AO2
		1.5.14	**Use** equal (equivalent) ratios to solve for unknown values in proportional reasoning tasks.	AO2
		1.5.15	**Use** ratios to solve problems involving real world contexts such as conversions, comparisons, scaling, mixing, and concentrations.	AO2
6	Understand decimals and percentages.	1.6.1	**Know** and **understand** that a decimal is a representation of a fractional (real) number.	AO1
		1.6.2	**Distinguish** between rational and irrational numbers by identifying which can or cannot be expressed as a ratio of integers.	AO3

		1.6.3	**Identify** and **use** place values accurately in decimal numbers.	AO2
		1.6.4	**Know** and **understand** the difference between terminating and non-terminating decimals.	AO1
		1.6.5	**Know** and **understand** recurring decimals and represent them using dot notation (e.g., 0. $\dot{3}$), ellipses, or overbars.	AO1
		1.6.6	**Know** and **understand** that all terminating and recurring decimals can be written as exact fractions, while other decimals are only approximations.	AO1
		1.6.7	**Convert** between fractions and their equivalent decimals, and vice versa.	AO2
		1.6.8	**Know** and **understand** that a percentage is a number out of 100 and **explain** its relationship to decimals and fractions.	AO1
		1.6.9	**Calculate** the percentage of a given number.	AO2
		1.6.10	**Express** one number as a percentage of another (e.g., 2 is 40% of 5).	AO2
		1.6.11	**Convert** values between fractions, decimals, and percentages accurately.	AO2
		1.6.12	**Use** percentages to compare quantities in real-life and mathematical contexts.	AO3
		1.6.13	**Interpret** and **perform** calculations with percentages greater than 100%.	AO3
		1.6.14	**Solve** problems involving percentage increase, decrease, and reverse percentage.	AO2
		1.6.15	**Calculate** repeated percentage change using successive multiplication of factors.	AO2
		1.6.16	**Apply** the compound interest formula Total = P(1 + r/100)^n to solve real-life financial problems.	AO2
		1.6.17	**Recognize** and **express** very large or very small numbers using standard form $A \times 10^n$, where $1 \leq A < 10$ and n is an integer.	AO2
		1.6.18	**Use** the laws of indices to simplify multiplication and division involving numbers in standard form.	AO2
7	Understand measurements and accuracy.	1.7.1	**Demonstrate** an understanding that all measurements involve an element of approximation, and **explain** how units, instruments, and context affect the precision and accuracy of a measurement.	AO2
		1.7.2	**Convert** between standard and non-standard units of measurement using a given conversion factor.	AO2
		1.7.3	**Differentiate** between decimal places and significant figures and round values accordingly to a specified level of accuracy.	AO2
		1.7.4	**Know** and **understand** that a rounded value represents an interval and **identify** its possible range using the concepts of lower and upper bounds.	AO2
		1.7.5	**Calculate** upper and lower bounds of a given rounded number and **express** the resulting interval using inequality notation (e.g., $2.35 \leq x < 2.45$).	AO2
		1.7.6	**Apply** the concepts of upper and lower bounds in contextual problems involving measurement, area, or quantity.	AO2
		1.7.7	**Estimate** the value of numerical expressions involving fractions, powers, or surds by applying appropriate rounding or truncation strategies.	AO3

Algebra				
Aim: To turn mathematical problems into equations with unknown values in them, and manipulate those equations to solve real-world problems.				
	The learner will:	**SLO #**	**Assessment Criteria - The learner can:**	**Cognitive levels**
1	Understand the language of algebra.	2.1.1	**Know** and **understand** that a variable is a number that can take different values in an expression or equation.	AO1
		2.1.2	**Know** and **understand** that symbols can be used to represent unknown values or changing quantities in mathematical contexts.	AO1
		2.1.3	**Know** and **understand** that an expression is a mathematical statement consisting of numbers, variables, and operators without an equality or inequality.	AO1
		2.1.4	**Know** and **understand** that a formula is a mathematical rule or relationship that connects two or more quantities using algebraic expressions.	AO1
		2.1.5	**Know** and **understand** that an equation is a formula that states two expressions are equal in value.	AO1
		2.1.6	**Use** and **interpret** relational symbols ≤ (less than or equal to) and ≥ (greater than or equal to), and **describe** their meaning in written and symbolic form.	AO2
		2.1.7	**Know** and **understand** that an inequality is a statement comparing two expressions using <, >, ≤, or ≥.	AO1
		2.1.8	**Know** and **understand** that an identity is an equation that is always true for all values of the variable.	AO1
		2.1.9	**Know** and **understand** that a term is a part of an algebraic expression separated by + or – signs.	AO1
		2.1.10	**Know** and **understand** that a factor is a quantity that multiplies another quantity in an expression or equation.	AO1
		2.1.11	**Know** and **understand** that algebraic expressions follow the standard rules of arithmetic: commutativity, associativity, and distributivity.	AO1
2	Understand the notations used to make algebra easier to write.	2.2.1	**Use** standard algebraic notation to represent multiplication and division, such as; • $a\ b$ instead of $a \times b$, • $3a$ instead of $a + a + a$, or $3 \times a$ • a^2b instead of $a \times a \times b$, • a/b instead of $a \div b$, • $3/2\ a$ instead of $1.5\ a$.	AO2
		2.2.2	**Use** brackets to group terms in algebraic expressions and **recognize** their effect on order of operations.	AO2
		2.2.3	**Use and interpret index notation for positive or negative, integer, fractional or zero powers:** $a \times a \times a \equiv a^3$ $\frac{1}{a^3} \equiv a^{-3}$ $a^0 = \frac{1}{a^0} = 1$ $\sqrt[2]{a^2} \equiv a^{\frac{2}{2}}$ $\frac{1}{\sqrt{a}} \equiv a^{-\frac{1}{2}}$	AO2
		2.2.4	**Know and use the index laws to simplify expressions:** $x^m \times x^n \equiv x^{m+n}$ $x^m \div x^n \equiv x^{m-n}$ $(x^m)^n \equiv x^{mn}$	AO2
		2.2.5	**Evaluate** algebraic expressions by substituting values for variables and calculating the result.	AO2
		2.2.6	**Know and understand** that a 'Linear' expression is one where variables appear with a maximum power of 1 and identify such expressions in algebraic form.	AO1
		2.2.7	**Know** and **understand** that a 'Quadratic' expression is one that contains at least one variable, and the terms with the highest power are of the form $x\ 2$ and/or $x\ y$.	AO1
3	Understand how to simplify and manipulate algebraic expressions.	2.3.1	**Know** and **understand** that "simplify" is the process of rewriting an expression in a less complicated or more efficient form using fewer terms or simpler structures.	AO2
		2.3.2	**Simplify** expressions by collecting like terms.	AO2
		2.3.3	**Simplify** expressions by factoring out a common numerical or algebraic factor.	AO2

		2.3.4	**Simplify** expressions by cancelling identical terms in numerators and denominators or across equations.	AO2
		2.3.5	**Simplify** expressions by cancelling factors when they appear in both the numerator and denominator of algebraic fractions.	AO2
		2.3.6	**Simplify** algebraic fractions where numerators and/or denominators are numeric, linear, or quadratic.	AO2
		2.3.7	**Apply** the laws of indices to simplify expressions involving powers and variables.	AO3
		2.3.8	**Factorize** quadratic expressions in the general form ($a\ x\ ^2 + b\ x\ + c\ $), including the difference of squares pattern.	AO2
		2.3.9	**Rewrite** quadratic expressions in completed square form.	AO2
4	Understand how to manipulate algebraic expressions to solve problems.	2.4.1	**Expand** single brackets by multiplying a term across the bracket.	AO2
		2.4.2	**Expand** binomial expressions by multiplying two brackets.	AO3
		2.4.3	**Manipulate** algebraic fractions with linear or quadratic numerators and denominators through simplification and rewriting.	AO3
		2.4.4	**Use** algebraic manipulation and simplification to prove that two expressions are equivalent.	AO3
		2.4.5	**Know** and **understand** that a function is a rule that assigns each input exactly one output, and represent it using algebraic expressions.	AO1
		2.4.6	**Know** and **understand** the inverse of a function as the operation that reverses the effect of the original function.	AO1
		2.4.7	**Know** and **understand** direct proportion as a relationship between two variables in the form .	AO1
		2.4.8	**Manipulate** simple linear or rational equations to find the inverse function algebraically.	AO3
		2.4.9	**Know** and **understand** that a composite function is one where the output of one function is used as the input of another (notation not required).	AO1
		2.4.10	**Apply** algebraic techniques such as expansion, simplification, and substitution to justify conclusions and construct mathematical proofs.	AO3
5	Understand how to solve equations and inequalities.	2.5.1	**Know** and **understand** that 'solving' an equation is finding all values of the unknown variable that make the equation true.	AO1

		2.5.2	**Substitute** numerical values into algebraic expressions and formulas to calculate results.	AO2
		2.5.3	**Solve** linear equations in one variable, including those with the unknown on both sides.	AO2
		2.5.4	**Know** and **understand** that quadratic equations may have zero, one, or two real solutions.	AO1
		2.5.5	**Use** the 'Quadratic Formula', $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, to obtain the solutions to a quadratic equation of the form $ax^2 + bx + c = 0$ (equation given).	AO2
		2.5.6	**Solve** quadratic equations by rearranging, factorising, completing the square, or applying the quadratic formula.	AO3
		2.5.7	**Know** and **understand** that simultaneous equations are equations with shared unknowns and **explain** that their solutions satisfy all equations in the system.	AO1
		2.5.8	**Solve** simultaneous equations where both are linear, or one is linear and the other quadratic.	AO3
		2.5.9	**Rearrange** equations into iterative form suitable for approximation methods.	AO2
		2.5.10	**Use** iteration to find approximate numerical solutions to equations, given a starting value.	AO2
		2.5.11	**Formulate** linear, quadratic, or simultaneous equations from written problems, **solve** them, and **interpret** the results in context.	AO3
		2.5.12	**Express** exponential growth or decay problems using iterative models (e.g., compound interest formulas).	AO3
		2.5.13	**Solve** and **interpret** real-life growth and decay problems mathematically.	AO3
6	Understand sequences.	2.6.1	**Know** and **understand** that a sequence is an ordered list of numbers generated by a specific rule or function.	AO1
		2.6.2	**Distinguish** between term-to-term rules and position-to-term rules used to define sequences.	AO3
		2.6.3	**Apply** the rule of a given sequence to find specified terms.	AO2
		2.6.4	**Know** and **understand** arithmetic sequences and **identify** the common difference as the fixed interval between consecutive terms.	AO1
		2.6.5	**Know** and **use** the fact that the nth term of an arithmetic sequence is given by $x_n = a + d(n - 1)$ where a is the first term and d is the common difference.	AO2
		2.6.6	**Derive** the nth term formula of an arithmetic sequence.	AO3
		2.6.7	**Know** and **understand** geometric sequences and define the common ratio as the factor by which each term is multiplied to get the next.	AO1
		2.6.8	**Use** the formula for the nth term of a geometric sequence, $x_n = ar^n$ where a is the first term and r is the common ratio (r > 0, rational or surd).	AO2
		2.6.9	**Know** and **understand** that the triangular number sequence is one where objects can form equilateral triangles.	AO1
		2.6.10	**Use** the nth term formula for the triangular number sequence $x_n = \frac{n(n+1)}{2}$	AO2
		2.6.11	**Know** and **understand** the square number sequence and express it with the nth term formula $x_n = n^2$.	AO1
		2.6.12	**Know** and **understand** the cubic number sequence and express it with the nth term formula $x_n = n^3$.	AO1
		2.6.13	**Know** and **understand** that the 'Fibonacci Sequence' is the sequence where the nth term is the sum of the previous two terms , $x_n = x_{n-1} + x_{n-2}$ at the sequence is defined as starting [0, 1, 1,…].	AO1
		2.6.14	**Know** and **understand** a quadratic sequence as one in which the second difference between terms is constant.	AO1
		2.6.15	**Know** and **use** the nth term formula for quadratic sequences $x_n = ax^2 + bx + c$	AO2

Graphs				
Aim: To draw/plot accurate graphs from data sets or functions, and use them to extract additional data.				
	The learner will:	**SLO #**	**Assessment Criteria - The learner can:**	**Cognitive levels**
1	Understand how to draw graphs.	3.1.1	**Draw** horizontal and vertical axes using a ruler with precision and neatness.	AO2
		3.1.2	**Label** axes with appropriate variable names and include units of measurement where relevant.	AO2
		3.1.3	**Apply** correct scale to axes using increments of 1, 2, or 5; clearly **label** starting values if the scale does not begin at zero.	AO2
		3.1.4	**Plot** individual data points using crosses, ensuring that the center of the cross lies within half a square of the intended location.	AO2
		3.1.5	**Draw** a straight line of best fit for a linear data set using a ruler.	AO2
		3.1.6	**Label** each data set clearly when multiple sets are plotted on the same set of axes.	AO2
		3.1.7	**Construct** a gradient triangle that is at least half the height or width of the graph to calculate or represent gradient visually.	AO3
		3.1.8	**Shade** the region under a graph when required to represent area.	AO2
		3.1.9	**Draw** sketch graph axes with a ruler to represent general trends or function shapes.	AO2
		3.1.10	**Label** sketch graph axes with variable names but omit units to distinguish from measured data.	AO2
		3.1.11	**Sketch** the general shape of curves or graphs based on their algebraic form or qualitative trend.	AO3
2	Understand how to plot linear graphs in cartesian coordinates.	3.2.1	**Know** and **use** the Cartesian coordinate system to describe and locate points in two-dimensional space.	AO1
		3.2.2	**Plot** points and graphs using all four quadrants of the Cartesian plane.	AO2
		3.2.3	**Identify** the coordinates of given points on a graph and **describe** their positions accurately.	AO2
		3.2.4	**Calculate** the midpoint of a straight line segment given the coordinates of its endpoints.	AO2
		3.2.5	**Recognize** and **apply** the general form of a straight-line equation; $y = mx + c$.	AO2
		3.2.6	**Identify** graphs showing direct proportionality as straight lines through the origin in the form; $y = mx$.	AO3
		3.2.7	**Determine** the equations for horizontal lines, vertical lines, and diagonal lines that pass through the origin.	AO3
		3.2.8	**Determine** whether two lines are parallel or perpendicular by analyzing their gradients.	AO3
		3.2.9	**Construct** the equation of a straight line given either: (a) two points it passes through or (b) one point and its gradient.	AO3
		3.2.10	**Plot** straight-line graphs using their algebraic equations.	AO2
		3.2.11	**Determine** the gradient (m) and y-intercept (c) from a linear graph, and **interpret** these in context where applicable.	AO3
3	Understand graphs of functions.	3.3.1	**Plot** and **sketch** graphs of quadratic and simple cubic functions involving up to three terms.	AO2
		3.3.2	**Plot** and **sketch** graphs of the reciprocal function $y = \frac{1}{x}$ en $x \neq 0$, and exponential functions of the form $y = k^x$ where k is positive.	AO2

		3.3.3	**Sketch** the graphs of the trigonometric functions, and, for θ measured in degrees.	AO2
		3.3.4	**Apply** and **sketch** transformations of functions including vertical and horizontal translations, 1-D stretches, and reflections in the x-axis, y-axis, or line .	AO3
		3.3.5	**Use** graphs to determine the value(s) of x for a given y-value, or vice versa.	AO2
		3.3.6	**Identify** key features on function graphs such as roots (x-intercepts), y-intercepts, and turning points.	AO3
		3.3.7	**Determine** graphically the point(s) of intersection between two graphs, including cases with one linear and one non-linear function.	AO3
		3.3.8	**Know** and **use** the fact that the intersection of two graphs represents the solution to the equation $f_1(x) - f_2(x) = 0$.	AO3
		3.3.9	**Recall** and **apply** the equation of a circle centred at the origin; $x^2 + y^2 = r^2$	AO2
		3.3.10	**Draw** the graph of a circle given its equation in standard form.	AO2
		3.3.11	**Determine** the equation of a circle centred at the origin from its graphical representation.	AO3
		3.3.12	**Determine** the equation of the tangent to a circle at a given point using geometric or algebraic reasoning.	AO3
		3.3.13	**Use** graphs to approximate the solutions to equations, including axis intercepts (roots) and points of intersection for simultaneous equations.	AO3
		3.3.14	**Graph** linear inequalities in one or two variables, and quadratic inequalities in one variable, using solid lines ≥ and ≤, and dashed lines for < and >.	AO3
4	Understand gradients.	3.4.1	**Calculate** the gradient of a straight-line graph and **estimate** the area under it using box counting or polygonal methods.	AO2
		3.4.2	**Estimate** the gradient at a point and the area under a non-linear graph using approximation strategies such as tangents and numerical methods.	AO3
		3.4.3	**Solve** problems using gradient and area from graphs in both mathematical and real-life contexts.	AO3
		3.4.4	**Interpret** the gradient of a straight line as the rate of change of a function or relationship.	AO3
		3.4.5	**Interpret** the gradient at a specific point on a curve as the instantaneous rate of change.	AO3
		3.4.6	**Estimate** the average rate of change over an interval by approximating the curve with a straight line and calculating its gradient.	AO3
		3.4.7	**Determine** both average and instantaneous rates of change from chords and tangents using numerical, algebraic, or graphical techniques.	AO3
		3.4.8	**Recognize** that if x is inversely proportional to y, then the relationship is represented by the equation.	AO2
		3.4.9	**Plot** x against for inverse proportionality and **interpret** the gradient of the graph as the constant of proportionality.	AO3
		3.4.10	**Interpret** and **extract** information from real-life graphs including distance–time, velocity–time, and financial graphs (e.g., profit vs. time).	AO3

Geometry				
Aim: To analyse and draw shapes in two and three dimensions.				
	The learner will:	**SLO #**	**Assessment Criteria - The learner can:**	**Cognitive levels**
1	Understand the language of geometry.	4.1.1	**Know** and **understand** that a dimension is a measure of extent in a single direction, and **use** the terms 1-D, 2-D, and 3-D to describe the number of dimensions an object occupies.	AO2
		4.1.2	**Know** and **understand** that a point is an exact location with no size or dimension.	AO1
		4.1.3	**Know** and **understand** that a straight line is an infinite 1-dimensional set of points extending in both directions.	AO1
		4.1.4	**Know** and **understand** that segment is a finite part of a line with two endpoints and measurable length.	AO1
		4.1.5	**Know** and **understand** that an edge is a line segment that forms part of the boundary of a 2-D shape.	AO1
		4.1.6	**Know** and **understand** that a vertex is a point where two or more edges meet.	AO1
		4.1.7	**Know** and **understand** a plane is a flat, two-dimensional surface that extends infinitely in all directions.	AO1
		4.1.8	**Know** and **understand** that a polygon is a closed 2-D shape formed by at least three straight edges.	AO1
		4.1.9	**Distinguish** between regular polygons (equal sides and angles) and irregular polygons.	AO2
		4.1.10	**Name** and **identify** polygons with 3 to 10 sides: Triangle, Quadrilateral, Pentagon, Hexagon, Heptagon, Octagon, Nonagon, and Decagon.	AO1
		4.1.11	**Know** and **understand** parallel lines as lines that are always the same distance apart and never intersect.	AO1
		4.1.12	**Know** and **understand** a right angle as a 90° angle, typically marked with a square corner.	AO1
		4.1.13	**Know** and **understand** that perpendicular lines are lines that intersect at a right angle.	AO1
		4.1.14	**Know** and **understand** a perpendicular bisector as a line that crosses a line segment at its midpoint and at a 90° angle.	AO2
		4.1.15	**Know** and **use** the geometric naming convention to describe points, line segments, and angles (e.g., point A, segment AB, angle ∠ABC).	AO2
		4.1.16	**Know** and **understand** that perimeter is the total length around the boundary of a polygon, and **calculate** it by summing the side lengths.	AO1
2	Understand angles between lines.	4.2.1	**Know** and **use** the fact that the sum of the angles on a straight line is 180°.	AO2
		4.2.2	**Know** and **use** the fact that the sum of the angles around a point is 360°.	AO2
		4.2.3	**Know** and **understand** that when a line crosses two parallel lines, the resulting angles fall into three categories: alternate, allied, and corresponding angles.	AO1
		4.2.4	**Know** and **understand** that alternate angles are equal and describe their 'Z-shape' pattern when a transversal cuts the two parallel lines.	AO1
		4.2.5	**Know** and **understand** that allied (or co-interior) angles are supplementary (add to 180°), and **describe** their “C-shape” or “U-shape” pattern.	AO1
		4.2.6	**Know** and **understand** that the corresponding angles are equal and **describe** their 'F-shape' pattern.	AO1
		4.2.7	**Use** alternate, allied, and corresponding angle rules to **calculate** unknown angles in diagrams with parallel lines.	AO2
		4.2.8	**Know** and **understand** interior angles as angles inside a polygon and exterior angles as angles between one side and the extension of an adjacent side.	AO1

		4.2.9	**Know** and **understand** the rule that an interior angle and its adjacent exterior angle form a linear pair (sum to 180°).	AO1
		4.2.10	**Know** and **understand** the fact that the interior angles of a triangle add up to 180°.	AO1
		4.2.11	**Determine** the sum of interior angles in any polygon by dividing the shape into triangles.	AO3
		4.2.12	**Know** and **use** the fact that the exterior angle of a triangle equals the sum of the two opposite interior angles.	AO2
		4.2.13	**Know** and **use** the formulas: • Sum of interior angles of an n-sided polygon = (n-2) x 180 degrees • Sum of exterior angles of any polygon = 360°	AO2
		4.2.14	**Determine** the interior and exterior angles of a regular polygon.	AO3
		4.2.15	**Determine** unknown angles in diagrams using all known angle rules and properties.	AO3
3	Understand triangles.	4.3.1	**Know** and **understand** an equilateral triangle as a regular triangle with all sides and angles equal.	AO1
		4.3.2	**Know** and **understand** that an isosceles triangle is a triangle with two equal sides and two equal angles.	AO1
		4.3.3	**Know** and **understand** that a right-angled triangle is one that contains a 90° angle.	AO1
		4.3.4	**Know** and **understand** that the sides of a right-angled triangle are: hypotenuse (the longest side opposite the right angle), opposite (relative to a given non-right angle), and adjacent (the remaining side next to the given angle).	AO1
		4.3.5	**Know** and **understand** Pythagoras' Theorem $a^2 + b^2 = c^2$ to find missing side lengths in right-angled triangles.	AO1
		4.3.6	**Know** and **understand** that a scalene triangle is one with no equal sides or angles.	AO1
		4.3.7	**Know** and **use** the standard triangle naming convention where each side, angle, and vertex are represented by corresponding letters (e.g., side AB opposite angle C).	AO2
4	Understand quadrilaterals.	4.4.1	**Know** and **understand** that square is a quadrilateral with four equal sides and four right angles.	AO1
		4.4.2	**Know** and **use** the fact that in a square, opposite sides are parallel and diagonals bisect each other at right angles.	AO2
		4.4.3	**Know** and **understand** that a rectangle is a quadrilateral with four right angles and two pairs of equal opposite sides.	AO1
		4.4.4	**Know** and **use** the fact that in a rectangle, opposite sides are parallel, diagonals bisect each other, and every square is also a rectangle.	AO2
		4.4.5	**Know** and **understand** that a parallelogram is a quadrilateral with opposite sides equal in length and opposite angles equal in size.	AO1
		4.4.6	**Know** and **use** the fact that in a parallelogram, opposite sides are parallel, diagonals bisect each other, and every rectangle is a parallelogram.	AO2
		4.4.7	**Know** and **understand** that a rhombus is a quadrilateral with four equal sides and equal opposite angles.	AO1
		4.4.8	**Know** and **use** the fact that in a rhombus, opposite sides are parallel, diagonals bisect each other at right angles, all squares are rhombuses, and all rhombuses are parallelograms.	AO2
		4.4.9	**Know** and **understand** that a trapezium is a quadrilateral with exactly one pair of parallel sides.	AO1
		4.4.10	**Know** and **use** the fact that every parallelogram meets the definition of a trapezium.	AO2
		4.4.11	**Know** and **understand** that a kite is a quadrilateral with two distinct pairs of adjacent equal sides.	AO1
		4.4.12	**Know** and **use** the fact that in a kite, diagonals bisect each other at right angles, and that all rhombuses are kites.	AO2
5	Understand circles.	4.5.1	**Know** and **understand** that a circle is the set of all points that are a fixed distance from a central point, called the centre.	AO1

		4.5.2	**Know** and **understand** that the radius is the distance from the centre of the circle to any point on the circle.	AO1
		4.5.3	**Know** and **understand** that the diameter is a line segment that passes through the centre and has endpoints on the circle; understand that the diameter is twice the radius.	AO1
		4.5.4	**Know** and **understand** that the circumference is the perimeter or total distance around a circle.	AO1
		4.5.5	**Know** and **understand** that a chord is a line segment with both endpoints on the circle, not necessarily passing through the centre.	AO1
		4.5.6	**Know** and **understand** that a tangent is a line that touches the circle at exactly one point.	AO1
		4.5.7	**Know** and **understand** that an arc is a continuous portion of the circle's circumference between two points.	AO1
		4.5.8	**Know** and **understand** that a sector is the area bounded by two radii and the arc between them; **identify** the major sector as the larger region and the minor sector as the smaller.	AO1
		4.5.9	**Know** and **understand** that a segment is the area bounded by a chord and the arc connecting its endpoints; **identify** the major segment as the larger region and the minor segment as the smaller.	AO1
6	Understand the circle theorems.	4.6.1	**Know** and **use** the fact that a tangent to a circle is perpendicular (90°) to the radius at the point where it touches the circle.	AO2
		4.6.2	**Know** and **use** the fact that two radii and the chord joining their endpoints form an isosceles triangle.	AO2
		4.6.3	**Know** and **use** the fact that the perpendicular bisector of any chord passes through the centre of the circle.	AO2
		4.6.4	**Know** and **use** the fact that the angle at the centre of a circle is twice the angle at the circumference when both angles subtend the same arc.	AO2
		4.6.5	**Know** and **use** the fact that a triangle formed by a diameter and a point on the circle always has a right angle opposite the diameter.	AO2
		4.6.6	**Know** and **use** the fact that angles formed in the same segment (from the same chord) are equal, and that the angle in the major and minor segment always adds to 180°.	AO2
		4.6.7	**Know** and **use** the fact that opposite angles in a cyclic quadrilateral (where all vertices lie on the circle) always add up to 180°.	AO2
		4.6.8	**Know** and **use** the fact that the lengths of two tangents drawn from a point outside a circle to the circle are equal.	AO2
		4.6.9	**Know** and **use** the fact that the angle between a tangent and a chord is equal to the angle in the alternate segment of the circle.	AO2
		4.6.10	**Apply** known circle theorems (by name or description) to explain geometric relationships and solve problems involving angles and lengths in diagrams.	AO2
7	Understand congruent and similar shapes.	4.7.1	**Know** and **use** the fact that congruent shapes are shapes that are exactly the same in size and shape but may differ in orientation due to rotation or reflection.	AO2
		4.7.2	**Know** and **use** the triangle congruence using the rules; ○ SSS (Side-Side-Side) ○ AAS (Angle-Angle-Side) ○ SAS (Side-Angle-Side) ○ RHS (Right angle–Hypotenuse–Side) and use these criteria in geometric arguments.	AO2
		4.7.3	**Know** and **use** the fact that similar shapes as shapes that have the same form but may differ in size due to enlargement, rotation, or reflection.	AO2
		4.7.4	**Know** and **use** the fact that triangle similarity can be established by using the following rules: ○ Two corresponding angles are equal ○ All corresponding sides are proportional ○ Two sides are proportional and the angle between them is equal	AO2
		4.7.5	**Use** ratio and proportion to calculate unknown side lengths in similar shapes.	AO2
		4.7.6	**Recognize** and **distinguish** between congruent and similar figures in diagrams.	AO3
		4.7.7	**Apply** the properties of congruent and similar shapes to complete or explain simple geometric proofs.	AO2
		4.7.8	**Know** and **use** the fact that line symmetry and rotational symmetry in 2-D shapes.	AO2

		4.7.9	**State** the number of lines of symmetry in a given polygon.	AO3
		4.7.10	Accurately **draw** all lines of symmetry for a polygon.	AO2
		4.7.11	**State** the order of rotational symmetry of a polygon.	AO2
		4.7.12	**Know** and **understand** that a shape with no rotational symmetry has an order of 1.	AO1
8	Understand construction methods.	4.8.1	**Know** and **understand** how to use a ruler, compass, and protractor accurately to construct geometric shapes and diagrams; show all construction lines clearly.	AO1
		4.8.2	**Know** and **understand** that a locus is a set of points that satisfy a given condition (e.g., a fixed distance from a point or line).	AO1
		4.8.3	**Construct** loci accurately using appropriate tools, showing all construction lines.	AO2
		4.8.4	**Construct** triangles using ruler and compass, or ruler and protractor, given sides and/or angles.	AO2
		4.8.5	**Construct** the locus of points at a fixed distance from a single point (a circle).	AO2
		4.8.6	**Construct** the angle bisector as the locus of points equidistant from two intersecting lines.	AO2
		4.8.7	**Construct** the perpendicular bisector of a line segment as the locus of points equidistant from two endpoints	AO2
		4.8.8	**Construct** a line perpendicular to another line through a given point.	AO2
		4.8.9	**Construct** accurate angles of 60° and 90° using compass and straightedge.	AO2
		4.8.10	**Construct** the locus of points at a fixed distance from a straight line (parallel lines).	AO2
		4.8.11	**Construct** the locus of points at a fixed distance from a line segment (capsule shape).	AO2
		4.8.12	**Draw** regions satisfying a set of given geometric constraints using construction techniques.	AO2
		4.8.13	**Know** and **understand** the fact that the shortest distance from a point to a line is measured along the perpendicular.	AO1
		4.8.14	**Use** construction to demonstrate that the perpendicular line represents the shortest distance from a point to a line.	AO2
		4.8.15	**Interpret** written geometric descriptions and produce accurate diagrams using construction tools.	AO3
9	Understand transformations.	4.9.1	**Know** and **understand** that a translation is a movement in a straight line, represented by a vector, and apply translations to geometric shapes by shifting each vertex.	AO1
		4.9.2	**Draw** the image of a shape after translation using a given vector.	AO2
		4.9.3	**Know** and **understand** that a rotation is a circular movement around a fixed point (centre of rotation), described by angle, direction, and centre.	AO1
		4.9.4	**Draw** rotations of 90°, 180°, or 270° clockwise or anti-clockwise about a given point.	AO2
		4.9.5	**Know** and **understand** that a reflection is a flip over a line of symmetry, described by the equation of the reflection line (e.g.,y=x).	AO1
		4.9.6	**Draw** reflections of shapes in the x-axis, y-axis, and the line.	AO2
		4.9.7	**Identify** single transformations that leave a shape unchanged in appearance.	AO3
		4.9.8	**Describe** how a shape changes under combinations of transformations and **relate** the outcome to the original position.	AO3
		4.9.9	**Know** and **understand** that an enlargement is a transformation that changes the size of a shape about a centre, described using a scale factor and centre of enlargement.	AO1

		4.9.10	**Interpret** the scale factor of an enlargement: ○ Scale factor > 1 enlarges ○ Scale factor < 1 reduces ○ Negative scale factor produces an image on the opposite side of the centre, rotated 180°.	AO3
		4.9.11	**Draw** enlargements of geometric shapes with scale factors such as 4, 3, 2, ½, ⅓, and ¼ (positive or negative).	AO2
		4.9.12	**Know** and **understand** how scale factor affects dimensions: ○ Lengths change by scale factor ○ Areas change by the square of the scale factor ○ Volumes change by the cube of the scale factor	AO1
		4.9.13	**Use** scale factors to interpret and extract information from scale diagrams and maps.	AO2
10	Understand 3D shapes.	4.10.1	**Know** and **understand** that a cube is a 3D shape with six square faces, equal edge lengths, and right angles between all faces.	AO1
		4.10.2	**Know** and **understand** that a cuboid is a 3D shape with six rectangular faces and all internal angles equal to 90°.	AO1
		4.10.3	**Know** and **understand** that a tetrahedron is a 3D shape with four triangular faces.	AO1
		4.10.4	**Know** and **understand** that a square-based pyramid is a 3D shape with one square face and four isosceles triangular faces meeting at a vertex.	AO1
		4.10.5	**Know** and **understand** a right prism is a 3D shape with a constant cross-section (e.g., cylinder, triangular prism).	AO1
		4.10.6	**Know** and **understand** that a sphere is a 3D shape with a surface that is always the same distance (radius) from a central point.	AO1
		4.10.7	**Know** and **understand** that a cone is a 3D shape with a circular base that tapers smoothly to a single vertex.	AO1
		4.10.8	**Draw** 3D shapes with straight edges and right angles using isometric grid paper.	AO2
		4.10.9	**Know** and **understand** that projections are 2D views of a 3D shape, including front elevation, side elevation, and plan view.	AO1
		4.10.10	**Draw** or sketch front, side, and top (plan) projections of 3D objects based on isometric drawings or given dimensions.	AO2
		4.10.11	**Interpret** projection (plan and elevation) drawings of 3D objects.	AO3
		4.10.12	**Know** and **understand** that a net is a 2D pattern that can be folded into a 3D solid.	AO1
		4.10.13	**Sketch** nets of common 3D shapes such as cubes, cuboids, pyramids, and prisms.	AO2
		4.10.14	**Use** the net of a 3D shape to calculate the total surface area of the shape by summing the areas of its faces.	AO3

Mensuration and Vectors				
Aim: To break complicated systems down into simpler systems where sizes can be easily found.				
	The learner will:	**SLO #**	**Assessment Criteria - The learner can:**	**Cognitive levels**
1	Understand how to find lengths, angles, perimeters and areas in 2D.	5.1.1	**Measure** line segments and angles accurately on scale drawings using a ruler and protractor.	AO2
		5.1.2	**Interpret** real-life maps and scale drawings by using measured lengths and angles.	AO3
		5.1.3	**Construct** straight lines and angles accurately on grid paper.	AO2
		5.1.4	**Calculate** the area of a triangle using the formula $Area = \frac{1}{2} \times (base \times height)$	AO2
		5.1.5	**Calculate** the areas of quadrilaterals using appropriate formulas: $Parallelogram: base \times height$ $Kite: width \times height$ $Trapezium: \frac{1}{2} \times (sum\ of\ parallel\ sides) \times vertical\ height$	AO2
		5.1.6	**Calculate** the circumference and area of a circle using $Circumference = 2\pi r = \pi d$ $Area = \pi r^2$	AO2
		5.1.7	**Calculate** arc length, sector area, and perimeter of a circular sector given the angle at the centre.	AO2
		5.1.8	**Calculate** the angle at the centre of a sector when given its arc length, perimeter, or area.	AO2
		5.1.9	**Calculate** the area and perimeter of composite 2D shapes by decomposing them into combinations of triangles, quadrilaterals, and sectors.	AO2
2	Understand how to find the surface areas and volumes of 3D shapes.	5.2.1	**Calculate** the surface area of cuboids, right prisms, regular tetrahedrons, and square-based pyramids.	AO2
		5.2.2	**Calculate** the surface area of a sphere using the formula $4\pi r^2$	AO2
		5.2.3	**Calculate** the surface area of a cone using the formula $A = \pi rl + \pi r^2$ where r is the base radius and l is the slant height (formula provided).	AO2
		5.2.4	**Calculate** the surface area of a cylinder using the formula $A = 2\pi rh + 2\pi r^2$ where r is the base radius and h is the height (formula provided).	AO2
		5.2.5	**Calculate** the surface area of related shapes, such as hemispheres or truncated cones, by adapting standard formulas.	AO2
		5.2.6	**Calculate** the volume of cuboids and right prisms using; Area of the front face × Depth of prism (Formula given)	AO2
		5.2.7	**Calculate** the volume of a sphere using the formula, $\frac{4}{3}\pi r^3$ here r is the radius (formula provided).	AO2
		5.2.8	**Calculate** the volume of a cone using $Volume\ of\ the\ cone = \frac{\pi r^2 h}{3}$ where r is the base radius and h is the height (formula provided).	AO2
		5.2.9	**Calculate** the surface area and volume of composite 3D shapes by breaking them down into simpler standard solids.	AO2
		5.2.10	**Use** the properties of similar or congruent shapes in 2D and 3D to determine missing lengths, areas, or volumes.	AO2
3	Understand trigonometry.	5.3.1	**Know** and **use** the definitions of the trigonometric ratios for a right triangle: $\sin\theta$ = Opposite/Hypotenuse, $\cos\theta$ = Adjacent/Hypotenuse, $\tan\theta$ = Opposite/Adjacent.	AO2
		5.3.2	**Prove** that $\tan\theta = \sin\theta / \cos\theta$. (by trigonometric manipulation)	AO2
		5.3.3	**Know** and **use** the exact values of $\sin\theta$, $\cos\theta$ and $\tan\theta$ for the angles 0, 30, 45, 60 and 90 degrees, and explain why tan 90 is undefined.	AO2
		5.3.4	**Use** trigonometric functions to calculate unknown side lengths or angles in right-angled triangles.	AO2

		5.3.5	**Plot** and **sketch** graphs of the trigonometric functions, $\sin\theta$, $\cos\theta$, and $\tan\theta$, where θ is any angle in degrees.	AO2
		5.3.6	**Sketch** the graphs of sin, cos and tan after the transformations 'Enlarge' ($A\ f\ (\theta\ )$), 'Stretch' ($f\ (B\ \theta\ )$), and/or '(Phase) Shift' ($f\ (\theta\ +C\ )$).	AO2
		5.3.7	**Use** the 'Sine Rule' for finding unknown angles or side lengths of a general triangle, (equation given). $\frac{a}{\sin A}=\frac{b}{\sin B}=\frac{c}{\sin C}$	AO2
		5.3.8	**Use** the 'Cosine Rule' for finding unknown angles or side lengths of a general triangle, (equation given). $a^2=b^2+c^2-2bc\cos\theta$	AO2
		5.3.9	**Use** the area of a triangle sine rule, $Area=\frac{1}{2}ab\sin C$ to find the area, side lengths or angles of a general triangle (equation given).	AO2
		5.3.10	**Prove** the area of a triangle sine rule.	AO3
5.4	Understand vectors.	5.4.1	**Identify** scalar quantities as those with magnitude only (e.g. speed, distance, mass).	AO1
		5.4.2	**Identify** vector quantities as those with both magnitude and direction (e.g. velocity, displacement, force).	AO1
		5.4.3	**Know** and **use** vector notation, including row and column vectors, and the representations, $\overrightarrow{OA}$ and **v** {Students should also be aware that in written rather than typed text there are other notations, Any clear ar$\vec{a},\vec{b},$ or $\underline{c}$sistent notation in written answers will be accepted.}	AO1
		5.4.4	**Know** and **understand** how to multiply a vector by a scalar and interpret the result as a change in magnitude and/or direction.	AO1
		5.4.5	**Know** and **understand** how to add and subtract vectors numerically and algebraically, using component form.	AO1
		5.4.6	**Express** a given vector as a combination of other vectors when appropriate.	AO3
		5.4.7	**Know** and **understand** that the modulus (or magnitude) of a vector is its length and denote it as |v|.	AO1
		5.4.8	**Calculate** the modulus of a vector using Pythagoras' theorem in 2D.	AO2
		5.4.9	**Draw** vector diagrams, accurately labelling arrows to indicate direction and magnitude.	AO2
		5.4.10	**Draw** vectors on a grid, including those defined by magnitude and direction using bearings (e.g. "4 km at 065°").	AO2
		5.4.11	**Interpret** and **analyze** scale drawings and maps using bearings and vector directions.	AO3
		5.4.12	**Know** and **understand** the fact that translations can be represented by vectors.	AO1
		5.4.13	**Use** vectors to determine the image of a point after a translation in 2D.	AO2
		5.4.14	**Apply** vector methods to construct geometric arguments and simplify calculations.	AO3

Probability and Statistics				
Aim: To calculate and interpret probabilities based on models of random events or data from experiments.				
	The learner will:	**SLO #**	**Assessment Criteria - The learner can:**	**Cognitive levels**
1	Understand how probability applies to single events.	6.1.1	**Know** and **understand** an event is a describable situation where something may happen.	AO1
		6.1.2	**Know** and **understand** that an outcome is a possible result of an event, and the outcome as what actually occurs.	AO1
		6.1.3	**Know** and **understand** that a random event is one whose outcome cannot be predicted with certainty in advance.	AO1
		6.1.4	**Know** and **understand** that probability measures how likely an outcome is to occur and can be used to predict the likelihood of future events.	AO3
		6.1.5	**Know** and **understand** that probability values range between 0 (impossible) and 1 (certain), and can be expressed as fractions or decimals.	AO2
		6.1.6	**Interpret** values of 0 and 1 as representing certainty or impossibility.	AO2
		6.1.7	**Demonstrate** that no valid probability can be less than 0 or greater than 1.	AO3
		6.1.8	**Know** and **use** standard probability notation, e.g. P(Heads) = 0.5 or P(Red Card) = 26/52.	AO3
		6.1.9	**Describe** the likelihood of outcomes using qualitative labels and probability ranges:- - “Definitely will happen” [P = 1] - “Very likely” [P > 0.75] - “Likely” [P > 0.5] - “As likely as not” [P = 0.5] - “Unlikely” [P < 0.5] - “Very unlikely” [P < 0.25] - “Definitely won’t happen” [P = 0]	AO3
		6.1.10	**Use** and **justify** the rule: P(event happens) + P(event does not happen) = 1	AO2
		6.1.11	**Show** (by examples) that the sum of the probabilities of all possible outcomes of an event is always equal to 1.	AO2
		6.1.12	**Know** and **understand** “Equally Likely” outcomes as having the same probability, and describe such an event as fair.	AO1
		6.1.13	**Identify** events with unequal outcomes as biased or unfair.	AO1
		6.1.14	**Know and use** the formula for equally likely outcomes: $\text{Probability} = \frac{\text{Number of wanted outcomes}}{\text{Total number of outcomes}}$	AO2
		6.1.15	**Apply** probability reasoning to single-step events such as spinning a spinner, picking a card, or rolling a die.	AO2
2	Understand how probability applies to multiple events.	6.2.1	**Know** and **understand** mutually exclusive outcomes as outcomes where only one can occur at a time.	AO1
		6.2.2	**Show** that for an exhaustive set of mutually exclusive events, the sum of their probabilities is equal to 1.	AO3
		6.2.3	**Use** the rule that probabilities for all possible outcomes must sum to 1 to calculate missing probabilities.	AO2
		6.2.4	**Recognize** that in repeated experiments, relative frequency (outcome frequency ÷ total trials) estimates probability.	AO2
		6.2.5	**Explain** that small sample sizes may produce unreliable probability estimates, and that estimates improve with more trials.	AO3
		6.2.6	**Use** past relative frequency data to estimate the probability of a future event.	AO2
		6.2.7	**Calculate** expected frequency of an outcome using:(Understand this as an estimate, not a certainty.)	AO2

		6.2.8	**Know** and **understand** the sample space as the full list of possible outcomes for one or more events (e.g. sample space for two coin tosses = {HH, HT, TH, TT}).	AO1
		6.2.9	**Identify** independent events as events where one outcome does not influence the other.	AO1
		6.2.10	**Identify** dependent events as events where the outcome of one affects the outcome of the other.	AO1
		6.2.11	**Know** and **apply** the AND rule for independent events:P(A and B) = P(A) × P(B)	AO2
		6.2.12	**Apply** the OR rule for mutually exclusive events:P(A or B) = P(A) + P(B)	AO2
		6.2.13	**Use** listing techniques and the Product Rule for Counting to identify all possible outcomes of multiple-event experiments.	AO2
		6.2.14	**Apply** probability reasoning to multi-event contexts such as drawing multiple cards, rolling dice multiple times, or similar repeated random processes.	AO3
3	Understand how to use tables and diagrams to calculate probabilities of multiple events.	6.3.1	**Construct** sample space diagrams (tables or grids) for two independent events to list all possible outcomes.	AO2
		6.3.2	**Use** sample space diagrams to calculate probabilities of specific combinations of outcomes, including mutually exclusive events.	AO3
		6.3.3	**Draw** and **interpret** Venn diagrams for two or more events, clearly labelling regions and sets.	AO2
		6.3.4	**Use** Venn diagrams to determine whether events are mutually exclusive or overlapping.	AO2
		6.3.5	**Calculate** the probability of an individual outcome or combined outcomes using set notation (e.g. P(A ∪ B), P(A ∩ B), P(A')).	AO2
		6.3.6	**Use** Venn diagrams to prove the OR rule for mutually exclusive events: P(A ∪ B) = P(A) + P(B)	AO3
		6.3.7	**Use** Venn diagrams to calculate the probability that at least one of two non-mutually exclusive events occurs: P(A ∪ B) = P(A) + P(B) – P(A ∩ B)	AO2
		6.3.8	**Draw** and **interpret** tree diagrams for two or more sequential events.	AO2
		6.3.9	**Know** and **use** the rule that the probabilities on each branch at a node in a tree diagram must sum to 1, and that the total probability of all final outcomes is 1.	AO2
		6.3.10	**Use** diagrams (sample spaces, Venn, tree) to list and count all combinations in compound events.	AO2
		6.3.11	**Calculate** probabilities for combinations of events (independent, dependent, or mixed) using structured diagrams.	AO2
		6.3.12	**State** any assumptions made during probability calculations (e.g. events are independent or equally likely).	AO1
		6.3.13	**Justify** why assumptions made in probability models (e.g. fairness, independence) are valid or reasonable.	AO3
		6.3.14	**Construct** and **interpret** two-way tables to organize frequency or probability data across two categorical variables.	AO3
		6.3.15	**Use** expected frequencies or probability models (such as tree diagrams or two-way tables) to **calculate** and **interpret** conditional probabilities.	AO3
4	Understand how to collect data.	6.4.1	**Know** and **understand** the population as the entire group you want to study (e.g. all people at an event).	AO1
		6.4.2	**Know** and **understand** a member as an individual within a population.	AO1
		6.4.3	**Know** and **understand** a sample as a subset of members from the population used to represent the whole.	AO1
		6.4.4	**Know** and **understand** that a representative sample reflects the structure of the population and allows general conclusions.	AO2
		6.4.5	**Know** and **understand** a random sample as one where every member has an equal chance of being selected.	AO1
		6.4.6	**Know** and **understand** that representative samples should be both random and large enough to avoid bias.	AO1

		6.4.7	**Identify** a biased sample as one that over-represents or under-represents certain groups (e.g. only sampling men to represent all drivers).	AO3
		6.4.8	**Know** and **understand** that, as sample size increases, the results of repeated, unbiased sampling tend to match theoretical probability distributions.	AO1
		6.4.9	**Identify** flaws in sampling methods, such as poor selection criteria or insufficient size.	AO3
		6.4.10	**Describe** simple random sampling methods (e.g. number generators, drawing names from a hat).	AO2
		6.4.11	**Describe** and **apply** stratified sampling, where subgroups are proportionally represented in the sample.	AO2
		6.4.12	**Use** the results of a sample to infer properties of the whole population or distribution.	AO3
		6.4.13	**Identify** and **explain** limitations of sampling (e.g. small size, non-randomness, under-coverage).	AO3
		6.4.14	**Recognize** that effective surveys use clear, unbiased questions and response options that are easily recorded.	AO3
		6.4.15	**Distinguish** between qualitative data (descriptive, e.g. colors, opinions) and quantitative data (numerical).	AO3
		6.4.16	**Classify** quantitative data as either discrete (fixed values) or continuous (any value in a range), and organize them into “classes.”	AO1
		6.4.17	**Represent** classes using equalities for discrete variables (e.g. “$X = 3$”) and inequalities for continuous ones (e.g. “$4 < X \leq 6$”).	AO1
		6.4.18	**Ensure** that grouped data classes cover all possible responses (e.g. avoid missing “exactly 6 feet” in a height question).	AO2
		6.4.19	**Explain** flaws in questionnaires or how data was collected (e.g. leading questions, unclear categories, overlapping groups).	AO3
5	Understand how to process data.	6.5.1	**Distinguish** between the three types of average: mode, median, and mean.	AO1
		6.5.2	**Know** and **understand** the mode as the most frequent value in a data set; recognize when a data set is bimodal, trimodal, or multimodal.	AO1
		6.5.3	**Know** and **understand** that the median as the middle value in an ordered data set; for even-sized sets, calculate the average of the two central values.	AO1
		6.5.4	**Calculate** the mean by dividing the sum of all values by the number of values in the data set.	AO2
		6.5.5	**Calculate** and **interpret** the mean, median, and mode for given data sets.	AO2
		6.5.6	**Evaluate** the advantages and disadvantages of each average and select the most appropriate average for interpreting a given data set.	AO3
		6.5.7	**Know** and **understand** the range and interquartile range (IQR) as measures of data spread.	AO1
		6.5.8	**Calculate** the range as the difference between the highest and lowest values in the data set.	AO2
		6.5.9	**Know** and **understand** quartiles as values that divide an ordered set into four equal parts: - Q1 = 25% mark (lower quartile) - Q2 = 50% mark (median) - Q3 = 75% mark (upper quartile)	AO2
		6.5.10	**Calculate** the interquartile range as Q3 – Q1.	AO2
		6.5.11	**Draw** and **interpret** stem-and-leaf diagrams to determine quartiles and ranges.	AO2
		6.5.12	**Draw** and **interpret** box plots to represent quartiles, range, and IQR graphically.	AO2
		6.5.13	**Draw** and **interpret** frequency tables to find the mode, mean, and range for discrete data.	AO2
		6.5.14	**Draw** and **interpret** grouped frequency tables to identify modal and median classes and to estimate the mean and range for continuous data.	AO2

		6.5.15	**Compare** two data sets by analyzing their central tendency and spread, and comment on any outliers or anomalies that affect interpretation.	AO2
6	Understand statistical data graphs.	6.6.1	**Draw** and **interpret** common data representations, including tables, bar charts, pictograms, and pie charts.	AO2
		6.6.2	**Construct** and **interpret** cumulative frequency graphs to estimate quartiles and the interquartile range (IQR).	AO3
		6.6.3	**Use** cumulative frequency graphs to estimate the number of values above or below a given threshold.	AO3
		6.6.4	**Construct** histograms from grouped frequency tables using frequency density on the vertical axis.	AO2
		6.6.5	**Use** data from a histogram to complete a grouped frequency table.	AO2
		6.6.6	**Draw** frequency polygons using grouped data to visualize the distribution of values.	AO2
		6.6.7	**Construct** and **complete** two-way tables to represent relationships between two categorical or numerical variables.	AO2
		6.6.8	**Plot** scatter graphs from paired data sets and **draw** a line of best fit where appropriate.	AO3
		6.6.9	**Use** interpolation (within the data range) and extrapolation (beyond the data range) to make approximate predictions.	AO3
		6.6.10	**Describe** the risks and limitations of interpolation and especially extrapolation when interpreting trends.	AO3
		6.6.11	**Know** and **understand** that correlation as the relationship between two variables and explain that correlation does not imply causation.	AO1
		6.6.12	**Know** and **understand** correlation in terms of strength (strong, weak, none) and direction (positive, negative).	AO1
		6.6.13	**Use** scatter graphs to **identify** and **justify** correlation descriptions based on plotted data.	AO3
		6.6.14	**Draw** conclusions and **interpret** key trends or features in a statistical data set using appropriate terminology.	AO3

FORMULA SHEET

Algebra

$$Compound\ interest = P\left(1 + \frac{r}{100}\right)^n$$

$$n^{th}\ term\ of\ Arithmetic\ sequence\ (a_n) = a_1 + (n-1)d$$

$$n^{th}\ term\ of\ Geometric\ sequence\ (a_n) = a_1 r^{n-1}$$

$$n^{th}\ term\ of\ Triangular\ sequence\ (a_n) = n \times \frac{(n+1)}{2}$$

$$n^{th}\ term\ of\ Quadratic\ sequence\ (a_n) = an^2 + bn + c$$

$$Quadratic\ Formula: x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Kinematics

$$s = ut + \frac{1}{2}at^2$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

Geometry

$$Area\ of\ a\ triangle = \frac{1}{2} \times (base\ \times height)$$

$$Area\ of\ a\ parallelogram = base\ \times height$$

$$Area\ of\ a\ Kite = base\ \times height$$

$$Area\ of\ a\ Trapezium = \frac{1}{2} \times (sum\ of\ parallel\ sides) \times vertical\ height$$

$$Circuference\ of\ a\ circle = 2\pi r = \pi d$$

$$Area\ of\ a\ circle = \pi r^2$$

$$Surface\ Area\ of\ a\ Sphere = \pi r^2$$

$$Surface\ Area\ of\ a\ Cone = \pi rl + \pi r^2$$

$$Surface\ Area\ of\ a\ Cylinder = 2\pi rh + 2\pi r^2$$

$$Volume\ of\ the\ sphere = \frac{4}{3}\pi r^3$$

$$Volume\ of\ the\ cone = \frac{\pi r^2 h}{3}$$

$$Cosine\ rule: a^2 = b^2 + c^2 - 2bc\ cos\theta$$

$$Area\ of\ a\ triangle\ sine\ rule = \frac{1}{2}ab\ sinC$$