MATHEMATICS   SEC 23

SYLLABUS

Mathematics SEC 23	Available in September (Paper I and Paper IIB only)
Syllabus	Paper I: Section A (20 minutes) & Section B (1 hr 40 minutes) + Paper II (2 hours)

Introduction

Mathematics furnishes the prime means by which information can be organised, communicated and manipulated. It is also an ever-expanding body of facts, skills, concepts and strategies used in the solution of a wide range of problems. As a consequence, when implementing this syllabus, teachers of Mathematics should emphasize two important aspects of the teaching and learning of mathematics:

(i)   **Utilitarian Aspect of Mathematics Teaching and Learning**

Mathematics is useful. It equips individuals with the necessary knowledge to help them understand and interact with the world around them. Moreover, it forms the basis of science, technology, architecture, engineering, commerce, industry and banking. It is also increasingly being used in the medical sciences, biological sciences, economics and geography. This pervasiveness makes Mathematics one of the most important subjects in the school curriculum.

(ii)   **Aesthetic Aspect of Mathematics Teaching and Learning**

Mathematics is an evolving body of knowledge that is characterised by its order, precision, conciseness and logic. It should offer the individuals intellectual challenge, excitement, satisfaction and wonder.

Aims

When implementing this syllabus, teachers should aim to enable candidates to:

- Understand and appreciate the place and purpose of Mathematics in society and apply mathematical concepts to situations arising in their own lives;
- Apply mathematical knowledge and understanding to solve problems;
- Think and communicate mathematically - precisely, logically and creatively;
- Develop a positive attitude to Mathematics, including confidence and perseverance;
- Develop an ability to work independently and co-operatively when doing Mathematics;
- Appreciate the interdependence of the different branches of Mathematics;
- Acquire a secure foundation for the further study of Mathematics;
- Use Mathematics across the curriculum; and,
- Make efficient, creative and effective use of appropriate technology in Mathematics.

Assessment Objectives

The examination will, in general, test:

- The candidate's ability to recall, understand and apply mathematical knowledge in a wide context;
- The candidate's ability to understand and analyse a problem, select an appropriate strategy, apply suitable knowledge and techniques to solve it, verify and interpret the results; and,
- The candidate's ability to understand, interpret and evaluate mathematical ideas that are presented in oral, written and visual forms.

In particular, the candidate will be required to demonstrate the ability to:

- Communicate, conjecture, reason and prove mathematically;
- Understand the nature of numbers and make use of them;
- Understand the nature of algebraic relationships and make use of them;
- Understand the nature and properties of shape, space and measures and make use of them;
- Understand the nature of statistics and process, represent and interpret data; and,
- Understand the nature of probability and calculate the probabilities of events.

During the course candidates should be given opportunities to:

- Use calculators and computer software including spreadsheets, LOGO, a dynamic geometry package and computer algebra system;
- Use computers as a source of large samples, as a tool for exploring graphical representations, and as a means for simulating events;
- Develop a feel for numbers;
- Develop and use a range of methods of computation, namely, mental, pencil-and-paper, calculator and computer methods, and apply these to a range of problems;
- Develop and use a range of methods for approximation of numbers and apply these to a range of problems;
- Develop and use a range of methods for estimation of measures and apply these to a range of problems;
- Explore a variety of situations which lead to the expression of relationships;
- Consider how relationships between number operations underpin the techniques for manipulating algebraic expressions;
- Consider how algebra can be used to model real-life situations and to solve problems;
- Explore shape and space through drawing and practical work;
- Use computers to generate and transform graphic images and to solve problems;
- Formulate questions that can be solved using statistical methods;
- Undertake purposeful inquiries based on data analysis;
- Engage in practical and experimental work in order to appreciate principles which govern random events; and,
- Look critically at some of the ways in which representations of data can be misleading and conclusions can be uncertain.

Scheme of Assessment

The examination will consist of two papers, **Paper I** and **Paper II**, each of 2 hours duration. There will be two versions of Paper II: Paper IIA and Paper IIB. **Candidates who intend to further their study in Mathematics and Science subjects at Intermediate Level and Advanced Level are <u>STRONGLY</u> advised to sit for Paper IIA.**

Questions will be set in English and must be answered in English.
Candidates are expected to abide by the following principles of good mathematical practice:

- inclusion of justifications in solutions whenever appropriate;

- specification of the number of decimal places/significant figures being used whenever numbers are rounded up or down, and

- inclusion of all appropriate steps in solutions to problems.

Paper I

This paper is to be taken by all candidates and will cover the Core Syllabus content only.
It will be divided into **two Sections**, **A** and **B**.

Section A (Non-Calculator Section)

- It will consist of eighteen to twenty short questions to be answered in 20 minutes.
- The paper will carry a total of 20 marks.
- **Calculators and protractors are not allowed**.
- Questions will typically involve numerical calculations, approximations, estimations, data and graphical interpretations, application of formulae, recall and applications of properties of shapes, recall and applications of mathematical facts
- To answer these questions, particularly those involving numerical calculations, candidates are advised to choose and use the more efficient techniques (mental and pencil-and-paper). They are expected to have a range of strategies to aid mental calculations of unknown facts from facts that can be rapidly recalled.

Section B (Calculator Section)

- It will consist of nine to eleven compulsory graded questions to be answered in one hour and forty minutes.
- The questions may have different mark allocations which will be stated on the paper and will carry a total of 80 marks.
- **Candidates are allowed to use mathematical instruments and scientific calculators with statistical functions. Programmable calculators are not allowed.**
- **Candidates are allowed to use transparencies for drawing transformations.**

Paper II

There will be two versions of this paper (IIA or IIB). Candidates will be required to indicate on the registration form which version they wish to sit for. No change in the choice of paper will be allowed after the registration period. In the September supplementary session only Paper I and Paper IIB will be offered.

Candidates are allowed to use mathematical instruments and scientific calculators with statistical functions. Programmable calculators are not allowed.
Candidates are allowed to use transparencies for drawing transformations.

Paper IIA will consist of nine to eleven compulsory questions with varying mark allocations per question which will be stated on the paper, carrying a total of 100 marks. The questions in this paper will cover the content in both the Core and the Extension parts of the syllabus. A typical problem in this paper will be more difficult to solve than a typical Paper I problem. The time allowed for this Paper is two hours.

Paper IIB will consist of twenty to twenty-eight questions with varying mark allocations stated on the paper and will carry a total of 100 marks. The questions in this paper will cover the content in that part of the syllabus indicated as Core. A typical problem in this paper will be easier to solve than a typical Paper I problem. The time allowed for this Paper is two hours.

The overall weighting (±5%) for each of the four main components of the syllabus is shown below:

	Number	**Algebra**	**Shape, Space & Measures**	**Data Handling**
Paper I and Paper IIA	25%	35%	30%	10%
Paper I and Paper IIB	35%	20%	35%	10%

Results

Candidates sitting for **Paper I** and **Paper IIA** may qualify for Grades **1**, **2**, **3**, **4** or **5**. The results for candidates who do not obtain at least a Grade **5** shall remain Unclassified (**U**).
Candidates sitting for **Paper I** and **Paper IIB** may qualify for Grades **4**, **5**, **6**, or **7**. The results for candidates who do not obtain at least a Grade 7 shall remain Unclassified (**U**).

Grade Descriptions

The following descriptions are meant to provide a general indication of the standards of achievement normally shown by candidates earning particular grades. However, the final grade awarded will reflect the extent to which the candidates have met the assessment objectives overall.

Grade 1 is awarded to candidates whose answers exhibit:

o   An understanding of complex non-routine problems;
o   Logical reasoning and valid conclusions;
o   An overall high performance in all areas of the syllabus;

o   A high level of presentation (providing evidence of effective and clear communication through writing and diagrams); and,
o   Correct computations and solutions.

Grade 5 is awarded to candidates whose answers exhibit:

o   An understanding of routine problems;
o   An acceptable amount of reasoning and valid conclusions;
o   An average performance in most areas of the syllabus; and,
o   An adequate level of presentation and communication.

Grade 7 is awarded to candidates whose answers show:

o   An understanding of simple routine problems;
o   A poor performance in all areas of the syllabus; and,
o   Some attempt at communication.

Table of Formulae

A table of the formulae reproduced below will be provided for the use of the candidates. These formulae will be provided for Paper IIA only.

Area of a Triangle	$\frac{1}{2}ab\sin C$
Curved Surface Area of Right Circular Cone	πrl
Surface Area of a Sphere	$4\pi r^2$
Volume of a Pyramid /Right Circular Cone	$\frac{1}{3}$ base area $\times$ perpendicular height
Volume of Sphere	$\frac{4}{3}\pi r^3$
Solutions of $ax^2 + bx + c = 0$	$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Sine formula	$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$
Cosine formula	$a^2 = b^2 + c^2 - 2bc\cos A$

Syllabus

The syllabus is divided into four main areas:

* **Number**
* **Algebra**
* **Shape, Space and Measures**
* **Data Handling**

Candidates taking **Paper IIB** need only cover the **Core** content (shown in normal type).

Candidates taking **Paper IIA** have to cover the **Core** content (shown in normal type) and the **Extension** content (shown in **bold** type).

Examples are shown in *italic*.

Although the syllabus is divided into four areas, it is very important that candidates see and make connections between these different areas.

Area 1: Number

Ref. No.	Core	Extension

1.1	**1.1.1 Integers**
	
	• Recognise, understand and use
	   - integers
	   - factors (divisors), multiples, least common multiple, prime numbers and prime factor decomposition.
	• Understand and use positive and negative numbers in real life contexts *(e.g. to find the temperature difference between temperatures below zero).*
	
	1.1.2 Sequences
	
	• Generate number sequences.
		1.1.1 Integers
		
		Recognise, understand and use highest common factor

1.2	**1.2.1 Fractions** • Understand and use fractions in real life contexts. • Recognise equivalent fractions. • Simplify fractions. • Order fractions. • Convert fractions to decimals and vice-versa. • Understand that simple fractions can be represented as recurring decimals. • Understand that fractions which in their lowest terms are of the form $m/(2^p 5^q)$ are non-recurring (m, p, and q are non-negative integers or zero).	
1.3	**1.3.1 Decimal Numbers** • Understand and use decimals in real life contexts. • Recognise recurring and non-recurring decimals. • Order decimals by using place value and by their position on the number line.	
1.4	**1.4.1 Numerical Operations** • Use the four operations $(+, -, \times, \div)$ in calculations with integers, decimals and fractions. • Identify the precedence of mathematical operations (BIDMAS). **1.4.2 Indices** • Understand that the reciprocal of a number is its multiplicative inverse. • Understand and use index notation (*e.g.* 7^3, 7^{-2}) • Understand and use the terms: square, square root, cube and cube root. • Understand and use the index laws for multiplication and division of integer powers. **1.4.3 Standard form** • Understand and use the standard index form expressed in conventional notation.	**1.4.2 Indices** **Use the index laws for positive and negative fractional powers.**

1.5	**1.5.1 Percentages**	**1.5.1 Percentages**
	• Understand and use percentages in real life contexts. • Interpret percentage as "number of parts per hundred". • Convert simple fractions to percentages and vice-versa *(e.g. Interpret 10% of 40 as 10/100 × 40)*. • Express a quantity as a percentage of another. • Calculate percentage increase and decrease *(e.g. a 15% increase in value of C = 1.15 × C; a 20% discount on € 250 = 0.2 × 250)*. • Determine the original value given the final value and the percentage change. *(e.g. to find the cost price given the selling price and percentage profit)*.	• **Make repeated use of a multiplier raised to a power (growth or decay factor).**
1.6	**1.6.1 Ratio** • Use ratio notation in practical situations *(e.g. in maps and scale drawings)*. • Recognise the connection between ratios and fractions. • Reduce ratios to their simplest form. • Divide a quantity in a given ratio. **1.6.2 Proportion** • Understand and use the elementary ideas and notation of direct and inverse proportion. • Calculate an unknown quantity from quantities that vary in direct or inverse proportion. **1.6.3 Rates of Change** • Understand and use the elementary ideas of common measures of rates of change *(e.g. to calculate the average speed)*.	
1.7	**1.7.1 Measures** • Understand and use metric units of mass, length, area, volume and capacity in practical situations. • Express quantities in terms of larger and smaller units. • Calculate time in terms of the 12-hour and 24-hour clock. • Read and interpret clocks, dials and time-tables. **1.7.2 Scales** • Read and use scales in practical situations *(e.g. read a thermometer scale)*.	
1.8	**1.8.1 Money** • Understand and use money in practical situations. • Convert from one currency to another. • Solve problems on personal and household finance involving earnings *(e.g. stocks)*, simple interest, tax and insurance.	**1.8.1 Money** • **Make repeated use of a multiplier raised to a power to compute compound interest (including borrowing and repayment), appreciation or depreciation.** • **Use a calculator and spreadsheet to investigate factors affecting these.**

		• **Determine, by trial and error, the number of years by means of a calculator.**
1.9	**1.9.1 Estimation and Approximation** • Make estimates of measures, rounding to a specified number of significant figures and decimal places to reasonable accuracy in the context of a given problem • Make sensible approximations in calculations involving multiplication and/or division.	**1.9.1 Estimation and Approximation** • **Understand and use limits of accuracy.** • **Give appropriate upper and lower bounds for data given to a specified accuracy** *(e.g. measured lengths).* • **Obtain appropriate upper and lower bounds to solutions of simple problems** *(e.g. the calculation of the perimeter or area of a rectangle given data to a specified accuracy).*
1.10	**1.10.1 The Calculator** • Use the calculator efficiently and effectively. • Know how to enter complex calculations. • Understand the calculator display, interpreting it appropriately. • Know when not to round during intermediate steps of a calculation. • Know how to interpret numbers displayed in standard form. • Know how to enter numbers in standard form. • Apply appropriate checks of accuracy (*e.g. working backwards from a solution; making approximations to check the reasonableness of the result or reworking calculations*).	

Area 2: Algebra

Ref. No.	Core	Extension

2.1	**2.1.1 Algebraic representation**
	
	• Use letters to represent generalised numbers.
	• Understand that algebraic entities can be transformed according to well-defined properties of generalised arithmetic.
	• Use input/output function (number) machines to define functions.
	• Understand and use function notation <mark>*(e.g. f(x) = 3x − 5).*</mark>
	• Manipulate algebraic expressions by:
	  • collecting like terms,
	  • multiplying a single term over a bracket,
	  • taking out a single term common factor,
	  • simplifying rational expressions with numeric denominators *(e.g. write $\frac{2z-3}{5} - \frac{z-5}{2}$ as a single fraction)*.
		2.1.1 Algebraic representation
		
		• **Use output/input inverse function (number) machines.**
		• **Use inverse function notation *(e.g. if $f(x) = 3x − 5$, then $f^{-1}(x) = (x + 5)/3$).***
		• **Expand the product of two linear expressions *(e.g. $(x + 1)(x − 2) = x^2 − x − 2$)***
		• **Factorise expressions involving difference of two squares and trinomials *(e.g. $2x^2+5x-12 = (2x-3)(x+4)$).***
		• **Use rational expressions with algebraic denominators *(e.g. write $\frac{1}{x+2} + \frac{x}{x^2-4}$ as a single fraction).***

2.2	**2.2.1 Equations and Inequalities**
	
	• Construct simple linear equations from given situations.
	• Solve linear equations.
	• Solve simultaneous linear equations in two unknowns:
	  – Graphically by interpreting the common solution as the point of intersection,
	  – Algebraically by elimination and by substitution
		2.2.1 Equations and Inequalities
		
		• **Solve simple linear inequalities in one variable and represent the solution set on a number line *(e.g. $2x − 3 > 7$).***
		• **Determine the solution to an inequality or set of inequalities on a graph by shading the appropriate region(s) *(e.g. $y \geq 3x, y \leq 5$ and $x + y > 4$)***
		• **Solve quadratic equations, by factorisation, by completing the square and by formula.**
		• **Solve a linear equation and a quadratic equation simultaneously.**
		• **Use trial and improvement methods involving calculator and computers to find approximate solutions of equations for which there is not a simple method of solution *(e.g. solve $x^3 − x = 80$).***

2.3	**2.3.1 Formulae** • Use formulae arising in mathematics and in other subjects. • Substitute numbers in a formula. • Derive a formula and change the subject of the formula. • Construct a formula on a spreadsheet.	**2.3.1 Formulae** • **Transform more complicated formulae.**
2.4	**2.4.1 Graphs** • Understand and use Cartesian coordinates in two dimensions. • Recognise that equations of the form $y = mx + c$ represent straight lines. • Construct table of values for linear and quadratic functions.	**2.4.1 Graphs** • **Construct tables of values for cubic functions and reciprocal functions of the type $f(x) = a/x$, using pencil and paper, a spreadsheet or a graphing package to generate points and plot the graphs.** • **Solve graphically linear, quadratic, cubic**

	• Plot and draw graphs of such functions by making use of pencil and paper methods, a spreadsheet and a graphing package. • Read off values from graphs. This includes reading values of x from the graph of the function $f(x)$ to solve an equation $f(x) = k$ where k is a real number. • Understand, interpret and calculate the gradient of a line from the coordinates of two points on it. • Find the gradient of a line from its equation. • Obtain the equation of a straight line in the form $y = mx + c$. • Know and understand that parallel lines have equal gradients. **2.4.2 Information Graphs** • Interpret information presented in a variety of linear and non-linear graphs *(e.g. distance-time and velocity-time graphs, conversion graphs, graphs of height against age).*	**and reciprocal functions simultaneously** *(e.g. find graphically common solutions for y = 2x – 1 and y = x³).*
2.5	**2.5.1 Indices** • Use and interpret positive and negative integral indices, including zero. • Use the index laws in simple instances. • Solve simple exponential equations by inspection *(e.g. $2^x = 16$).*	**2.5.1 Indices** • Use and interpret fractional indices.
2.6	**2.6.1 Sequences** • Generate a sequence using term to term and position-term definitions of the sequence. • Use expressions to describe the nth term of a simple sequence. • Generate terms of a sequence from the nth term.	
2.7		**2.7.1 Variation** • Solve problems involving direct and inverse variation to determine unknown quantities — restricted to $y \propto x^n$, where $n = \pm 1, \pm 2, 3$.

Area 3: Shape, Space and Measures

Ref. No.	Core	Extension

3.1	**Euclidean Geometry**
	
	3.1.1 Angles
	
	• Understand and use properties of angles at a point, angles on a straight line, vertically opposite angles.
	• Distinguish between acute, obtuse and reflex angles.
	• Estimate the size of an angle in degrees.
	
	3.1.2 Lines and Line Segments
	
	• Distinguish between lines and line segments.
	• Use parallel lines, alternate angles, corresponding angles and interior angles on the same side and between the same parallel lines.
	
	3.1.3 Triangles
	
	• Understand a proof that the angle sum of a triangle is 180°.
	• Understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices.
	• Use the angle properties of equilateral, isosceles and right-angled triangles.
	• Understand a proof of Pythagoras' Theorem.
	• Understand the converse of Pythagoras' Theorem.
	• Use Pythagoras' Theorem and its converse in 2-D situations.
	
	3.1.4 Quadrilaterals
	
	• Understand a proof that the angle sum of a quadrilateral is 360°.
	• Understand and use the properties of the square, rectangle, parallelogram, trapezium, rhombus and kite.
	• Classify quadrilaterals using their geometric properties.
	
	3.1.5 Polygons
	
	• Calculate and use the sums of the interior and exterior angles of regular and irregular polygons.
	• Use a formula, such as $(2n - 4)$ right angles or $(n - 2) \times 180°$, for the sum of the interior angles of a polygon with n sides.
	
	3.1.6 Circles
	
	• Understand the meaning of terms related to the circle: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment.
	• Understand and use the angle properties of the circle to calculate unknown angles:
	  ▪ The angle in a semicircle is a right angle.
	  ▪ The angle at the centre is twice the angle at the circumference.
		3.1.3 Triangles
		
		• **Use Pythagoras' Theorem in 3-D situations** *(e.g. to determine lengths inside a cuboid)*.
		
		3.1.6 Circles
		
		• **Understand the proofs of the angle properties of a circle.**
		• **Understand the proof of the alternate segment property.**

	▪ Angles in the same segment are equal. ▪ Angles in opposite segments are supplementary. ▪ The angle between the radius and the tangent at the point of contact is a right angle. Reasons justifying the use of these angle facts in simple riders are expected.	

3.2	**3.2.1 Constructions**
	
	• Carry out constructions based on measurement.
	• Estimate, measure and draw lines and angles.
	• Construct parallel lines.
	• Construct angles of 60° and 90° using compasses.
	• Construct simple 2-D geometric figures from given data.
	• Use straight edges and compasses to construct
	  ▪ the perpendicular bisector of a line segment,
	  ▪ the perpendicular from a point to a line,
	  ▪ the bisector of an angle.
	• Read and make scale drawings *(e.g. to solve right-angled triangles).*	

3.3	**Mensuration** **3.3.1 Flat (2-D) Shapes** • Find the perimeter and area of rectangles and triangles by counting unit measures and by formula. • Find the area of a parallelogram. • Find the area of a trapezium. • Find the area of compound flat shapes. • Find the circumference and area of a circle. • Find the length of arc as a fraction of the circumference. • Find the area of sector as a fraction of the area of a circle. **3.3.2 Solid (3-D) Shapes** • Find the surface area of a cube, cuboid, cylinder and pyramid. • Find the surface area of simple compound solid shapes involving cubes, cuboids, cylinders and/or pyramids. • Find the volumes of cuboids by counting unit measures and by formula. • Find the volume of a prism and cylinder. • Find the volume of simple compound solid shapes involving cubes, cuboids and prisms.	**3.3.1 Flat (2-D) Shapes** • **Find the area of acute and obtuse angled triangles using $\frac{1}{2}ab\sin C$.** • **Find the area of segments in a circle.** **3.3.2 Solid (3-D) Shapes** • **Find the surface area of a right circular cone.** • **Find the surface area of a sphere.** • **Find the volume of a pyramid and a frustum of a pyramid.** • **Find the volume of a right circular cone and a frustum of a right circular cone.** • **Find the volume of a sphere.**
3.4	**3.4.1 Symmetry and Congruency** • Use properties of shapes in tessellations. • Understand and know when shapes are congruent. • Appreciate the uniqueness of triangles satisfying SSS, SAS, ASA and RHS. • Understand and use SSS, SAS, ASA and RHS conditions to prove the congruence of triangles. • Understand and know when shapes are similar. • Understand and use AAA, the common ratio property	**3.4.1 Symmetry and Congruency** • **Prove the symmetry properties of the circle through congruency.** • **Understand and use the relationship between lengths, areas and volumes of similar shapes.**

	of sides, and, two common ratios and the included angle to prove similarity of triangles.
	• Appreciate that all congruent shapes are similar but similar shapes are not necessarily congruent.
	• Appreciate that any two circles and any two squares are mathematically similar, whereas, in general, two rectangles are not.
	• Recognise line and rotational symmetry in two dimensions.
	• Recognise the order of rotational symmetry.
	• Recognise properties of triangles, quadrilaterals and circles related to their symmetries.
	• Use the symmetry properties of the circle and their converse to prove that:
	  ▪ Equal chords are equidistant from the centre.
	  ▪ The perpendicular bisector of a chord passes through the centre.
	  ▪ Tangents from an external point are equal.	

3.5	**Trigonometry** **3.5.1 Trigonometric ratios** • Understand, recall and use the trigonometric relationships in right-angled triangles, namely, sine, cosine and tangent. • Use the trigonometric ratios to solve problems in simple practical situations *(e.g. in problems involving angles of elevation and depression)*.	**Trigonometry** **3.5.1 Trigonometric ratios** • **Extend the use of the sine and cosine functions to angles between 90° and 180°.** • **Solve simple trigonometric problems in 3-D.** *(e.g. find the angle between a line and a plane and the angle between two planes).* **3.6.2 Sine and cosine rules** • **Use the sine and cosine rules to solve any triangle.**
3.6	**3.6.1 Bearings** • Interpret and use three-figure bearings measured clockwise from the north. • Use scale drawings and trigonometrical ratios to solve problems involving bearings.	
3.7	**3.7.1 Transformation Geometry** • Recognise, describe and construct translations and reflections of plane figures. • Recognise, describe and construct rotations and enlargements about the origin of plane figures. • Recognise that reflections, rotations and translations preserve length and angle, so that figure is congruent to its image under any of these transformations. • Recognise that enlargements preserve angle and not length. • Understand and use the effect of enlargement on the perimeter of 2-D shapes. (In questions requiring candidates to construct transformations on the Cartesian plane, the mirror lines of constructing reflections will be restricted to the axes, $y = \pm x$, $y = \pm c$, $x = \pm c$ .The angles of rotation for constructing rotations will be restricted to multiples of	**3.7.1 Transformation Geometry** • **The scale factor for constructing enlargements will be extended to include negative numbers.** • **Transform plane figures by a combination of transformations.** • **Find the centre of rotation for rotations through 90°.** • **Understand and use the effect of enlargement on the perimeter of plane figures.**

	90°.The scale factor for constructing enlargements will be restricted to a positive integer or a fraction.Column vectors will be used to describe translations).	

3.8	**3.8.1 Loci**
	
	• Apply the following locus properties in two dimensions in practical situations:
	  ▪ The locus of points which are at a fixed distance from a given point.
	  ▪ The locus of points which are equidistant from two given points.
	• Devise instructions for a computer to produce the desired shapes and paths *(e.g. equilateral triangles and hexagons).*
		3.8.1 Loci
		
		• Use the following loci in two dimensions:
		  ▪ The locus of points which are equidistant from a straight line.
		  ▪ The locus of points which are equidistant from two intersecting straight lines.
		• Use intersecting loci.

Area 4: Data Handling

Ref. No.	Core	Extension
4.1	**4.1.1 Statistics** • Collect, classify and tabulate statistical data *(e.g. gather data from Information and Communication Technology (ICT) sources)*. • Read, interpret and draw simple inferences from tables and statistical diagrams. • Understand, use and construct, by both pencil and paper and ICT methods, bar charts, pie charts, simple frequency distributions and histograms with equal intervals. • Calculate and interpret the range, mean, median and mode for discrete and continuous data. • Use appropriate statistical functions on a calculator and a spreadsheet to calculate these statistics.	**4.1.1 Statistics** • **Understand and use histograms with unequal intervals.** • **Interpret and construct cumulative frequency curves.** • **Interpret and construct box plots to illustrate or compare distributions with large data sets.** • **Estimate the median, the lower and upper quartiles and the interquartile range from cumulative frequency curves.** • **Calculate the mean, median and mode for grouped data.** • **Identify the modal class from a grouped frequency distribution.**
4.2	**4.2.1 Probability** • Calculate the probability of a single event. • Construct simple possibility space diagrams *(e.g. for the throw of a coin and a die)*. • Work out the combined probability outcomes of two independent events.	**4.2.1 Probability** • **Calculate the probability for combined events, using possibility space diagrams and tree diagrams where appropriate.** **(In tree diagrams outcomes will be written at the end of the branches and probabilities by the sides of the branches).**