MATHEMATICS SYLLABUS (issued in 2003)

FORM 5 JUNIOR LYCEUM ONLY are to follow this syllabus
for Scholastic Year 2009 / 2010

The Forms 1-4 Syllabi
which appear in this document
are no longer valid and have been replaced.

CONTENTS

THE SECONDARY MATHEMATICS CURRICULUM

1. RATIONALE

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 that:

(i) Mathematics is useful. It equips children 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.
(Utilitarian Aspect of Mathematics Teaching and Learning)

(ii) Mathematics is an evolving body of knowledge that is characterised by its order, precision, conciseness and logic. It should offer the children intellectual challenge, excitement, satisfaction and wonder.
(Aesthetic Aspect of Mathematics Teaching and Learning)

2. AIMS

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;
- make efficient, creative and effective use of appropriate technology in Mathematics.

3. ASSESSMENT OBJECTIVES

Assessment is based on

- 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;
- 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;
- 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 a 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;
- look critically at some of the ways in which representations of data can be misleading and conclusions can be uncertain.

4. THE SYLLABUS CONTENT

The syllabus content for Forms 1, 2 and 3 is core material only; that for Forms 4 and 5 includes both core material and extension material. The underlined content indicates that it is extension material. This facilitates differentiated teaching and learning and the possibility of implementing setting. Students who cover the extension material will, by the end of Form 5, be able to sit for Matsec Paper A while those who don't will be able to sit for Matsec Paper B.

IMPORTANT NOTE

Changes from previous syllabus are printed in italics.

Secondary Schools Mathematics Syllabus
Junior Lyceum
Form 1

NUMBER

1.1	**Properties of whole numbers: odd, even, prime, factors and multiples, common factors and common multiples, prime factors.**	**Notion of Least Common Multiple. Notion of square and square root.**
1.2	**Place value.**	**Ordering whole numbers. The meaning of multiplication and division by 10 and powers of 10.**
1.3	**The four rules applied to whole numbers.**	**To include multiplication and division by a two digit number. (More emphasis is to be made on the repeated subtraction method than on the traditional method.)**
1.4	**Number patterns and number sequences.**	**Know how to generate these on a spreadsheet.**
1.5	**Equivalence of fractions.**	**Ordering of fractions. Simple addition and subtraction of fractions.**
1.6	**Finding a fraction of a quantity.**	
1.7	**Multiplication and division of two simple fractions.**	**Restricted to realistic calculations in context.**
1.8	**Place value for decimals.**	**Decimals as extensions of natural numbers. Ordering decimals.**
1.9	**Decimals related to vulgar fractions.**	**Simple conversions are included.**

Pupils should be able to recall the multiplication facts up to 10.

They should be given opportunities to
i) develop and use flexibly a range of computation methods (mental and paper-and-pencil) and apply these to a range of problems;
ii) use computer software (e.g. pre-prepared spreadsheets) to consolidate all Number related concepts.
iii) carry out investigative work related to number.

1.10	The four rules applied to decimals.	To include multiplication and division by a two digit number.
1.11	Use of brackets for simple mixed operations on numbers.	
1.12	Percentages related to decimals and fractions.	Including simple conversions.
1.13	Finding a percentage of a quantity.	
1.14	Expressing one quantity as a percentage of another.	
1.15	Approximating to the nearest 10, 100, etc.	
1.16	Correcting to a given number of decimal places.	
1.17	Rough estimates.	Use estimation to check calculations.

PROPORTION

2.1	Direct proportion.	Through unitary method

APPLICATIONS

3.1	Measures of weight, length, area, volume and capacity in current units.	Use of units: t, kg, g; km, m, cm, mm; l, cl, ml. Conversion from one unit to another. Estimating measures related to everyday objects.
3.2	Time: 12-hour and 24-hour clock.	Conversion from one to the other. Calculating time intervals.
3.3	Simple practical problems involving number, measure, time and money.	

MENSURATION

4.1	**Perimeter and area of square and rectangle.**	**Use of m^2, cm^2, mm^2.** **Change of units of area.**
4.2	**Area of border and of simple compound shapes.**	
4.3	**Volume of cuboid.**	**Use of m^3, cm^3, mm^3** **Change of units of volume.** **Use of $V = l \times b \times h$ with V subject.**
4.4	**Relation between volume and capacity.**	**Use of 1000 cm^3 = 1 litre.**

Practical work involving squared paper, LOGO and Dynamic Geometry Software is expected.

GEOMETRICAL FIGURES AND THEIR PROPERTIES

5.1	**Use of protractor to draw and measure angles.**	**Estimating the size of angles.**
5.2	**Vertically opposite, supplementary, complementary angles.**	**Acute, obtuse and reflex angles.**
5.3	**Angles about a point, angles on a straight line.**	
5.4	**Tessellations.**	
5.5	**Line and rotational symmetry.**	***To identify the order of rotational symmetry, e.g. a square has rotational symmetry of order 4***
5.6	**The symmetry properties of the isosceles and equilateral triangles.**	**Through symmetry**

The pupils should be given opportunities to use LOGO and Dynamic Geometry Software to explore and discover geometrical properties.

Investigative work employing software or pencil and paper methods is expected.

5.7	**Angle sum property of the triangle.**	**A practical approach. Simple extension to the angles of a quadrilateral.**
5.8	**Lines, Rays and Line Segments.**	**Distinguish among them.**
5.9	**Parallel lines and associated angles.**	
5.10	**Construction of circle, square, rectangle, triangle and regular hexagon from simple data.**	**Construction of perpendiculars and parallels using protractor or set squares.**

ALGEBRA

6.1	**Function Machines.**	**Use of terms input and output.**
6.2	**Using letters for numbers: generalisation of simple arithmetic results.**	
6.3	**Algebraic notation: $2x$, $3x + y$, x^2, $5(x - 2)$.**	
6.4	**Simplifying an expression by collecting like terms.**	**Including simple use of brackets.**
6.5	**Addition and subtraction of directed numbers.**	**Practical applications.**
6.6	**Multiplication of a negative number by a positive or negative number.**	
6.7	**Using numbers for letters; simple substitution.**	
6.8	**Forming and solving simple equations.**	

Pupils should be given opportunities to consider how relationships between number operations underpin the techniques for manipulating algebraic expressions.
The teacher should provide pupils with tasks that make use of Computer Algebra Software and Spreadsheets to introduce and reinforce the related algebraic concepts.
The pupils should become sufficiently familiar with authoring expressions and equations and work with them in a CAS and a spreadsheet environment.

GRAPHS

7.1	**Use of coordinates.**	**Simple applications to illustrate the properties of common geometrical shapes.**
7.2	**Plotting points (as ordered pairs generated by function machines) to represent a simple set of coordinates linearly related (relating *input* to *x* and *output* to *y*).**	**Plot the points (1,3), (2,5), (3,7), (4,9), (5, 11) … generated by the function machine "double the input and add 1", i.e. $y = 2x + 1$.**

The pupils should be given opportunities to use CAS, DGS and spreadsheets. Tasks should be set to introduce and reinforce the concepts associated with graphs.

STATISTICS

8.1	**Collecting information and making a frequency table.**	**Involving only discrete data**
8.2	**Making and using bar charts.**	**To include simple cases of grouped frequencies.**
8.3	**Constructing and using pie charts.**	**Know also how to construct bar charts and pie-charts on a spreadsheet.**
8.4	**Pictographs.**	
8.5	**Mean and range.**	**Use the spreadsheet to calculate the mean and range of a set of data.**

Pupils should be given opportunities to carry out purposeful enquiries based on data analysis and use spreadsheets to display and analyse the collected data.

Secondary School Mathematics Syllabus
Higher Level
Form 2

NUMBER

1.1	**Revision of the four rules on whole numbers, decimals and fractions.**	
1.2	**Positive and negative integral indices.**	**The rules of multiplication and division of numbers in index form. Definition of negative integral indices using the rules for positive integral indices.**
1.3	**Numbers in the standard form**	**Changing to and from standard form.**
1.4	**Squares and Square Roots involving decimal numbers.**	
1.5	**Approximations**	**To the nearest 10, 100, . . . and to the nearest given place of decimal.**
1.6	**Significant figures.**	**Notation of significant figures and their use in approximations.**
1.7	**Rough estimates.**	**To include estimates of squares and square roots.**
1.8	**Revision of percentages.**	
1.9	**Percentage increase and decrease.**	**Use of multiplying factor (as a fraction and as a decimal) to calculate percentage increase and decrease.**

Pupils are expected to recall the multiplication facts up to 10.

They should be given opportunities to
i) develop and use flexibly a range of computation methods (mental and paper-and-pencil) and apply these to a range of problems;
ii) use computer software (e.g. pre-prepared spreadsheets) to consolidate number concepts.
iii) carry out investigative work related to Number.

USE OF CALCULATOR

2.1	**Use of the calculator is to be restricted to awkward calculations involving the four rules and to squares and square roots. Programmable or graphical calculators cannot be used in examinations.**	**Scientific calculators with statistical functions will be required.**
2.2	**To use the calculator efficiently students need to learn how:** **- to follow the correct sequence of operations;** **- to understand and interpret the calculator display appropriately;** **- to apply checks on accuracy through rough estimates, repeating calculations and reversing order of operation;** **- to retain sufficient accuracy during working to achieve required accuracy in the answer.**	**To round off calculations to the required degree of accuracy.**

Teachers are expected to make good use of the calculator as a teaching tool.

On the other hand pupils should know when it is sensible to use a calculator.

RATIO AND PROPORTION

3.1	**Revision of ratio.**	**Notation *a* : *b* or *a* to *b*.**
3.2	**Simplify ratios.**	**Relation with fractions.**
3.3	**Dividing a quantity in a given ratio.**	
3.4	**Finding missing quantities related in a given ratio.**	**Finding *r* from *r* : 3 = 3 : 2.** **Map ratio in the form 1 : *n*.**

3.5 Direct and inverse proportion.

APPLICATIONS

4.1 Further applications of number and measure to practical problems.

4.2 Problems involving rates.

To include rates involving money (bills, wages, currency conversion, . . .) and average speed.

4.3 Applications of averages, percentages, ratio and proportion.

Pupils are expected to carry out investigative work involving Number and carry out practical work utilising software (e.g. the spreadsheet).

MENSURATION

5.1 Area of triangle and parallelogram.

$A = {}^1/_2\, bh$; $A = bh$ with A, b or h as subject.

5.2 Circumference and area of circle

$C = 2\pi r$ with C or r as subject.
$A = \pi r^2$.

5.3 Volume of a prism.

$V = A \times h$.

5.4 Volume of cylinder.

$V = \pi r^2 h$.

5.5 Areas and Volumes of simple compound shapes.

Pupils should be given opportunities to discover, through software or otherwise, these results

GEOMETRICAL FIGURES AND THEIR PROPERTIES

6.1	**Revision of simple basic geometrical facts.**	**E.g. angles associated with parallel lines, angles at a point, . . .**
6.2	**The trapezium and its properties.**	
6.3	**The symmetry properties of the following figures through line and rotational symmetry: isosceles and equilateral triangle, square, rectangle, parallelogram, rhombus, kite, isosceles trapezium, regular hexagon and circle.**	***To complete a shape given the centre and order of rotational symmetry (including the use of the Cartesian plane)***
6.4	**The construction of these shapes from simple data.**	
6.5	**Construction of lines and angles, parallels and perpendiculars.**	**Any accurate method is acceptable.**
6.6	**Construction of angles of 60º and 90º. Constructions of the bisector of an angle. Construction of the perpendicular bisector of a line. Construction of a perpendicular from a given point.**	**Using ruler and compasses.**

Pupils should be given opportunities to use Dynamic Geometry Software and LOGO to explore and consolidate these concepts.

Pupils should be given opportunities to carry out these constructions by making use of software besides pencil and paper methods.

ALGEBRA

7.1	**Multiplication of directed numbers.**	
7.2	**Constructing a simple formula.**	
7.3	**Substitution.**	**Including negative values of the variables.**
7.4	**Changing the subject of a formula.**	**Involving only one operation.**
7.5	**Solving linear equations in one unknown.**	**Including the use of brackets and simple fractions with numerical denominators.**

Pupils should be given opportunities to consider how algebra can be used to model real-life situations and solve problems.

The teacher should provide pupils with tasks that make use of CAS and Spreadsheets to introduce and reinforce the related algebraic concepts.

STATISTICS AND PROBABILITY

8.1	**Constructing a frequency table for grouped data.**	**Grouping data using equal class intervals for discrete and continuous variables.**
8.2	**Constructing and interpreting bar charts using grouped data.**	
8.3.	**Collecting information.**	**Designing and using a questionnaire to collect data (discrete and continuous).**
8.4	**Mean, median, mode and range.**	**For discrete data only.**
8.5	**Definition of probability.**	**For events which can be listed. e.g. throwing a number with a die, selecting a red card from a pack, etc.** **The probability scale from 0 to 1.** **P (A) = 0, P (A) = 1, P (A) = 1 – P (A).** **Discuss likelihood of an event happening using un/likely, very un/likely events with equally likely outcomes.**

Pupils are expected to carry out purposeful enquiries based on data analysis and use spreadsheets to display and analyse the collected data.

Pupils are expected to know how to use the calculator to determine the mean for discrete and continuous data and how to use the spreadsheet to determine the mean, median, mode and range.

Pupils should be given opportunites to use spreadsheets to simulate random events.

8.6 Combination of two events.	**Listing the possibility space in tabular form.**	
8.7 Finding probability by experiment.		

GRAPHS

9.1 Plotting a straight line graph from its equation.	**Use of function machines to produce tables**	Pupils should be given opportunities to use CAS and spreadsheets to explore and consolidate the associated concepts.
9.2 The gradient of a straight line and its intercepts on the axes.		

TRANSFORMATIONS

10.1 Reflections and translations.	**Line symmetry as a reflection.**	Pupils should be given opportunities to explore and and practise these transformations not only by using pencil and paper methods but also using software, particularly DGS.
10.2 Find the image under reflection and translation.	**Use of $y = c$, $x = c$ as mirrors.**	
10.3 Using column vectors to describe translations.		

Secondary School Mathematics Syllabus
Higher Level
Form 3

NUMBER

1.1	Revision of whole numbers, fractions and decimals.	
1.2	Estimation and approximation.	To include estimation of $1/x, x^3$ and cube root of x. Approximation to a reasonable answer.
1.3	Positive and negative integral indices.	Definition of negative integral indices, using the rules for positive integral indices
1.4	Simple applications of the rules of indices.	
1.5	Numbers in the standard form.	Changing to and from standard form.
1.6	Square root and cube root using factors.	
1.7	Squares, square roots and reciprocals using the calculator.	Estimation of squares, square roots and reciprocals
1.8	Efficient use of calculator.	Refer to notes in Form 2 Syllabus.

Students should be able to recall the multiplication facts up to 10.

Pupils should be given opportunities to develop and use flexibly a range of computation methods, both mental and pencil and paper, and apply these to a range of problems.

APPLICATIONS

2.1	Application of number and measure to simple practical problems.	
2.2	Percentage change.	Increase and Decrease per cent as a decimal multiplier.
2.3	Finding original quantity given percentage change.	
2.4	Simple applications of percentages to profit and loss.	Other common applications like tax, discount commission, . . .
2.5	Calculation of simple interest as an application of percentage.	To include finding P, R, T through reasoning (Formula $I = PRT/100$ is not required.)

Pupils should be given opportunities to carry out tasks involving these concepts on a spreadsheet.

MENSURATION

3.1	Area of the triangle and parallelogram. Use of formula A = ½ base x height. Area of parallelogram = base x height.	Appreciate that triangles and parallelograms with same or equal bases and between same parallels have equal areas.
3.2	Area of trapezium.	
3.3	Curved and Total Surface Area of Cylinder. Volume of Cylinder.	Use of $A = 2\pi r^2 + 2\pi rh$. Use of $V = \pi r^2 h$, with V, r or h as subject. The relations: 1 litre = 1000cm^3 1000 litres = 1m^3
3.4	Mensuration of simple composite shapes.	

Pupils should be given opportunities to discover these results through practical work, including the use of Dynamic Geometry Software.

ALGEBRA

4.1	**Formulae.**	**Construction of simple formulae and substitution**
4.2	**Changing subject of formula.**	**New subject appears only once.**
4.3	**Simultaneous linear equations with two unknowns and related problems.**	
4.4	**Expansions of the type $a(b + c)$.**	
4.5	**Factorisation by taking out the common factor.**	
4.6	**Simplification of fractions through cancellation using factors.**	**To include addition and subtraction of expressions with numerical denominators.**

Pupils should be given opportunities to explore and and practise the associated algebraic concepts using Computer Algebra Software.

EQUATIONS AND GRAPHS

5.1	**The graph of the straight line.**	**The form $y = mx + c$.** **Lines $x = c$, $y = c$.** **Understand, interpret and calculate the gradient of a line from the coordinates of two points on the line.** **Using m and c to sketch a line.** **Writing the equation of a line given m and c.**
5.2	**Graphical solution of simultaneous linear equations.**	
5.3	**Quadratic Graphs.**	**Solution of $f(x) = c$.** **Identifying the Maximum / Minimum.**

Pupils should be given appropriate tasks involving the use of CAS and the spreadsheet to help them explore and consolidate these concepts.

GEOMETRY

6.1	**Revision of basic geometrical facts.**	**E.g. Angles at a point, angles associated with parallel lines, . . .**
6.2	**Prove that sum of angles in triangle is 360°.**	**To include proof that the exterior angle is equal to the sum of the two interior opposite angles.**
6.2	**Angle properties of a circle:** **(1) angle at centre is twice angle at circumference (to include the angle in a semicircle)** **(2) angles in the same segment are equal** **(3) opposite angles in a cyclic quadrilateral are supplementary** **(4) exterior angle of cyclic quadrilateral is equal to the interior opposite angle.**	**Questions may be set requiring simple logical deductions from given data.**
6.4	**Angle sum properties of convex polygons:**	
	(1) sum of interior angles.	**Sum is $180^\circ n - 360^\circ$ or $180^\circ (n-2)$ or $(2n-4)$ right angles.**
	(2) sum of exterior angles.	
	Regular polygons.	**Inscribing a regular polygon (only for integral values of $360^\circ / n$) in a circle with given radius.**
	Properties of the regular hexagon.	
6.5	**Pythagoras' Theorem.**	**(The converse is excluded.)**
	Application of Pythagoras' theorem.	**To include the solution of the isosceles triangle, also using the isosceles triangle formed by two radii and a chord.**
6.6	***Introduction to 3-figure bearings***	***Problems to include sketching of diagrams to represent information (excluding trig ratios and Pythagoras theorem)***

Pupils should be given opportunities to explore and and establish these results not only by using pencil and paper methods but also by employing software, particularly DGS.

Pupils should be given tasks involving also the use of LOGO and DGS to practice and consolidate these concepts.

6.7 Drawing a given shape to scale.	***To include problems involving heights, distances, angles of elevation and depression and 3-figure bearings.***	

TRIGONOMETRY

7.1 The trigonometric ratios for acute angles.		Pupils should be given opportunities to explore and consolidate these concepts using DGS.
7.2 Applications of these ratios.	**Simple problems in 2-D involving the solution of right angled triangles, isosceles triangles, and and angles of elevation and depression.**	

STATISTICS AND PROBABILITY

8.1 Histograms with equal intervals.		Pupils are expected to know i) how to use the calculator to determine the mean for discrete and continuous data ii) how to find the mean, median, mode and range on a spreadsheet. Pupils are expected to carry out purposeful enquiries based on data analysis and use spreadsheets to display and analyse the collected data. Pupils should be given opportunites to use spreadsheets to simulate randomly occurring events.
8.2 Mean, median, mode and range.	***Excluding the mean and median for grouped data***	
8.3 Revision of probability.	**Using only possibility space diagrams for two independent events.**	

TRANSFORMATIONS

9.1 ***Rotations about a given point restricted to multiples of 90°***	***Use of the Cartesian plane***	

Secondary School Mathematics Syllabus
Higher Level
Form 4

NUMBER

1.1	Highest Common Factor.	Review Least Common Multiple.
1.2	Positive and negative fractional indices.	Simplify expressions involving fractional indices, using factors and the laws of indices.
1.3	Powers and roots.	Use of calculator to evaluate powers and roots.
1.4	Estimation involving powers and roots.	
1.5	Simple calculations involving numbers	Know how to enter numbers in the in standard form on a calculator and interpret numbers displayed in standard form on the calculator.

Students should be able to recall the multiplication facts up to 10.

Pupils should be given opportunities to develop and use flexibly a range of computation methods, both mental and pencil and paper, and apply these to a range of problems.

APPLICATIONS

2.1	Application of number and measure to practical problems.	
2.2	Revision of Simple Interest.	Refer to note in Form 3 Syllabus.
2.3	Compound Interest. Appreciation and Depreciation.	Calculation of compound interest year by year. Use of multiplication factor $(1 + r/100)$ for calculation of compound interest for n years. The Compound Interest formula $A = P(1 + r/100)^n$ Use of calculator for finding A, P, r, n.

Students are expected to carry out purposeful enquiries on a spreadsheet to investigate these factors.

2.4 Periodical Borrowing and Repayments.

2.5 Calculation of tax, insurance, commission , . . .

2.6 Exchange rate calculations.

MENSURATION

3.1	Area of Triangle and Parallelogram.	Use of ½ ab sin *C* for area of triangle and *ab* sin *C* for area of parallelogram.
3.2	Length of arc, area of sector and area of segment.	Angles given in degrees and in decimals of a degree
3.3	Volume of Prisms.	
3.4	Curved surface area of the cone; total surface area of the cone; volume of cone.	$A = \pi rl$, $A = \pi rl + \pi r^2$. $V = \frac{1}{3}\pi r^2 h$
3.5	Surface area and volume of sphere.	$A = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$
3.6	Volume of the pyramid Surface area of pyramid	Use of $V = \frac{1}{3}$ base area × height
3.7	Mensuration of simple composite shapes.	To include volume of frustum.

ALGEBRA

4.1 **Changing the subject of the formula, with the intended subject occurring more than once.**

4.2 **The product of two linear expressions.** **e.g. Expand $(2x - 1)(x - 3)$; $(x + y)^2$.**

4.3 **Factorisation – common factors, difference of two squares and trinomials.**

4.4 **Simplification of fractions.** ***Excluding denominators with quadratic expressions.***

4.5 **Solution of quadratic equations.** **Solution by factors, trial and improvement and by formula.**

4.6 **Problems leading to quadratic equations.**

Students should be given opportunities to use Computer Algebra Software to explore and consolidate the associated algebraic ideas.

Students should be able to find trial by improvement solutions for a quadratic equation by using a calculator and a spreadsheet.

GEOMETRY

5.1	**Congruent triangles.**	**To include harder cases.**
5.2	**Revision of angle properties of circle.**	**Structured questions leading to the proofs of the angle properties may be set.**
5.3	**Symmetry properties of the circle:** **- equal chords are equidistant from centre;** **- the perpendicular bisector of a chord passes through the centre;** **- a tangent is perpendicular to the radius at the point of contact;** **- tangents from an external point are equal.**	**Structured questions leading to the proofs of the symmetry properties through congruency may be set.** **Questions requiring simple logical deductions from given data may be set.**
5.4	**Properties of similar triangles. Finding missing sides.**	**Using scale factor or proportion.**
5.5	**Similarity: lengths, areas and volumes of similar figures.**	
5.6	**Pythagoras' Theorem and its converse.**	**Applied in simple 2-D and 3-D problems.**

Students should be given opportunities to discover and establish the relative geometrical results following exploratory work on the computer utilising Dynamic Geometry Software.

Students are expected to make conjectures arising from their observed results and then put forward a proof to establish the general result.

TRIGONOMETRY

6.1 **Application of trigonometric ratios to the solution of problems on bearings and heights and distances.**

To include simple problems in 3-D, but not problems on angles between lines and planes.

GRAPHS

7.1 **Quadratic graphs.**

E.g. Plotting $f(x) = 2x^2 - 3x - 5$ for given values of x.

7.2 **Simple deductions from graphs.**

E.g. Finding maxima and minima, finding the solutions of $f(x) = c$.
(The gradient of the tangent at a point on the curve is excluded)

7.3 **Approximate solution of equations by the intersection of two graphs.**

At least one of the graphs being linear.

Students are expected to carry out purposeful tasks using CAS and spreadsheets to consolidate the associated ideas.

TRANSFORMATIONS

8.1	**Revision of Reflections and Translations.**	**To include reflection in $y = \pm x$**
8.2	**Rotations about a given point, restricted to multiples of 90°**	
	Finding the centre and angle of rotation.	**Location of centre by construction**
8.3	**Enlargement with positive and negative scale factors**	***To include fractional scale factors with and without the use of Cartesian plane***
8.4	**Combined Transformations**	**Transform a 2-D shape by a combination of transformations**
8.5	**Identify a transformation as a reflection, translation, rotation or enlargement or as a combination of basic transformations**	**Use appropriate language to describe fully the transformation**

Students are expected to make use of DGS and LOGO to facilitate the understanding and application of the concepts associated with this topic.

PROBABILITY

9.1	**Combined events**	**Use the sum and product laws for independent events**
9.2	**Dependent events**	**Use of tree diagrams for dependent events**

Secondary School Mathematics Syllabus
Higher Level
Form 5

NUMBER

1.1 Natural numbers and integers

Recognition of these sets. Recurring and non-recurring decimals – know that fractions with denominators that have only prime factors of 2 and 5 will terminate.

1.2 Estimation and approximation.
Limits of accuracy of a calculation involving one or two corrected variables.

e.g. Calculating range (upper and lower bounds) within which the volume of a cylinder must lie given corrected values of *r* and *h*.

Students should be able to recall the multiplication facts up to 10.

Students should be given opportunities to develop and use flexibly a range of computation methods, both mental and pencil and paper, and apply these to a range of problems.

ALGEBRA

2.1 Sequences and patterns.

Writing the *n* th term in simple cases.

2.2 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. to solve $x^3 - x = 80$.

2.3 Solving simultaneous equations - one linear and one quadratic.

2.4 Simplification of fractions.

***Denominators to include linear and quadratic expressions*.**

Students should be given opportunities to explore sequences and patterns from a variety of situations, using computers where appropriate.

2.5	**Function of a variable.**	**Function notation, *input*, *output*.**
2.6	**Find inverse functions**	**Use $f^{-1}(x)$ notation.**
2.7	**Solution of linear inequalities, using one variable**	**Representing solutions on the number line. e.g. solving $2x + 5 < 21$ and $x + 1 > 0$, giving $-1 < x < 8$.**
2.8	**Solution of linear inequalities, using two variables**	**Representing solutions in the Cartesian Plane The Maximum / Minimum value of a function in a region. e.g. $y \geq 3x$, $y \leq 5$ and $x + y > 4$**
2.9	**Direct and Inverse Variation**	**Finding the constant of proportionality for $y = kx^n$, $n = \pm 1, \pm 2, 3$**

Teachers should provide tasks which require the use of Computer Algebra Software, a graphing package and spreadsheets to introduce and consolidate the concepts associated with these topics.

GRAPHS

3.1	**Revise straight line graphs.**	**Find the gradient of a line; gradients of parallel lines; find the length of a line segment given two coordinates; use $y = mx + c$ to draw quick sketches of lines.**
3.2	**The graphs of quadratic functions, cubic functions and the reciprocal function a/x .**	**Knowledge of the form of simple functions viz. quadratic, cubic, reciprocal.**
3.3	**Solve graphically linear, quadratic, cubic and reciprocal functions simultaneously.**	**e.g. Solve simultaneously $y = 2x - 1$ and $y = x^3$.**
3.4	**Interpreting Travel Graphs.**	**Gradient of distance/time, speed/time graphs. Calculating distance for a *v-t* graph.**

Teachers should provide tasks which require the use of Computer Algebra Software, a graphing package and spreadsheets to introduce and consolidate the concepts associated with these topics.

GEOMETRY AND TRIGONOMETRY

4.1 Loci in two dimensions involving simple constructions. Use of intersecting loci.	**The locus of points which are at a fixed distamce from a given point; the locus of points equidistant from two given points; the locus of points which are equidistant from a straight line; the locus of points which are equidistant from two intersecting straight lines.**	Teachers should provide tasks which require the use of Dynamic Geometry Software to explore, introduce and consolidate the concepts associated with these topics.
4.2 Revision of angle and symmetry properties of a circle.		
4.3 Alternate segment property of the circle.	**A structured question leading to the proof of this property may be set. Questions requiring simple logical deductions from given data may also be set.**	
4.4 Trigonometric ratios of obtuse angles.		
4.5 Use of the Sine and Cosine Formulae for a triangle.	**To include their use in 3-D problems. Exclude the ambiguous case.**	

STATISTICS AND PROBABILITY

5.1	**Histograms with equal and unequal intervals.**	**Calculation of mean, median, mode and range from grouped and ungrouped frequency distributions.**
5.2	**The Cumulative Frequency Curve.**	**Constructing a cumulative frequency table and drawing the curve.**
5.3	**The median, quartiles and inter-quartile range.**	**Using the cumulative frequency curve.**
5.4	**Box plots.**	**To relate the range, the median and the lower and upper quartiles.**
5.5	**Miscellaneous problems on probability.**	

Teachers should provide tasks which require the use of spreadsheets to introduce and consolidate the concepts associated with these topics.

LIST OF FORMULAE

This is a list of the formulae that will be given during the examination. Students are expected to know other formulae not included in this list.

Area of a Triangle	$\frac{1}{2}ab\sin C$
Curved Surface Area of a 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 $ax^2 + bx + c = 0$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN MATHEMATICS

"Students learn by asking questions and by establishing connections . . . Students learn from everyday experiences through observation, listening, investigation, experimentation and the comparison of what has been discovered with what is already known . . . Learning is an organic process of invention and mental structuring and not a mechanical process of gathering information . . . Students need to change their modes of knowing in an active manner. Teachers or learning systems must facilitate this process. A healthy education therefore encourages . . . a pedagogy based on questioning . . . (and) on learning by doing . . . Students are not empty receptacles to be filled in . . ." ((National Minimum Curriculum – Principle 3: Stimulation of Analytical, Critical and Creative Thinking Skills – Ministry of Education - December 1999)

". . . The computer is still being given lip service. Apart from a change in mentality, one must seriously consider which physical and organizational changes are required of a school which seriously regards the computer as an indispensable learning vehicle." (National Minimum Curriculum – Principle 13: The Importance of Learning Environments – Ministry of Education - December 1999)

"*Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning*." (Principles and Standards for School Mathematics– NCTM April 2000)

ICT has the potential to make a significant contribution to pupils' learning in mathematics by helping them to:

- Practise and consolidate number skills (e.g. use a spreadsheet to revise number skills)
- Experiment with, make hypotheses from, and discuss or explain relationships in shape and space (e.g. use dynamic geometry software to investigate angle properties in a circle)
- Develop logical thinking and modify assumptions and strategies through immediate feedback (e.g. plan a series of instructions to draw a required shape or carry out a set of manipulations in a spreadsheet)
- Make connections within and across the different areas of mathematics (e.g. relate a function and its graph)
- Work with realistic sets of data (e.g. carry out experiments using random samples generated through simulation)
- Explore, describe and explain patterns and relationships in sequences and tables of numbers (e.g. use a formula on a spreadsheet to generate the given values)
- Develop skills of mathematical modelling through the exploration, interpretation and explanation of data (e.g. choose an appropriate graphical representation to display information from a set of data)

When using ICT teachers need to keep in mind that:

- ICT is employed because it is the most effective way to achieve teaching and learning objectives, not simply for reward or motivation.
- They should avoid the use of ICT for simple or routine tasks which would be better accomplished by other means.
- Pupils are expected to use ICT to answer valid questions appropriate to the subject matter being taught.

Teachers should therefore plan

- the ways in which ICT will be used to meet the teaching and learning objectives
- the key questions to ask and opportunities for teacher intervention in order to stimulate and direct pupils' learning
- the organization and conduct of the lesson and how the lesson is to be managed.

It cannot be emphasized strongly enough that the use of ICT in mathematics lessons can only be effective if it is used within the contexts of good mathematics teaching. Teachers therefore will have to set clear objectives for pupils' learning in mathematics and understand how the ICT used will help to support their teaching and their pupils' learning.

The following Internet sites are suitable for both children and teachers. These sites contain sources of downloadable software and teaching and learning resources:

MSW Logo http://www.softronix.com/logo.html
Dr Geo http://www..drgeo.seul.org
WinGeom http://math.exeter.edu/rparris/wingeom.html
Graphmatica http://www.pair.com/ksoft/

http://www.anglia.co.uk/educationa/mathsnet/software.html
http://forum.swarthmore.edu/dynamic.html
http://www.nrich.maths.org.uk/
http://www.argonet.co.uk/oundlesch/mlink.html
http://curric.magnet.mt (the Curriculum Department's website – click on *Links* for Maths Website)

FORM 1

Throughout the year children are expected to use EXCEL (a spreadsheet), LOGO (a programming language for children), DERIVE (Computer Algebra Software) and CABRI GEOMETRY II (Dynamic Geometry Software). The list outlined below gives an indication of what children are expected to know and do by the end of the year.

THE SPREADSHEET (EXCEL)

Children should be given opportunities to interact with pre-written spreadsheets to become familiar with the spreadsheet environment and to consolidate particular mathematical concepts. Gradually they should be given opportunities to learn how to

- Carry out simple calculations involving the four rules and generate even, odd, square numbers and multiples.
- Enter numerical data into the spreadsheet and use the built in functions SUM, AVERAGE, MAX, MIN.
- Construct simple bar charts and pie charts.

MICROWORLDS LOGO

Logo contributes a lot towards the mathematics curriculum. It is a highly enjoyable experience; it helps children develop mathematical concepts and skills; it enhances problem solving skills by encouraging them to think both algorithmically and procedurally; it gives rise to new learning and teaching styles, such as group work, investigative work and mathematical communication (with the computer and with class mates).

Children should be given opportunities to become familiar with the following Logo primitives.

PenUp	PU	PenDown	PD
Forward	FD	Back	BK
Right	RT	Left	LT
HideTurtle	HT	ShowTurtle	ST
ClearGraphics	CG	Repeat	REPEAT
Home			

OPTIONAL: They may also learn how to use SetColor SETC, SetBackGround SETBG, SetShape SETSH, Heading (to change direction in which the turtle points), FILL to colour a closed shape, CLEAN.

Typical activities using LOGO include:

- Drawing simple shapes or pictures made up of a number of simple primitives; e.g. letters of the alphabet, squares, rectangles, equilateral triangles, sheds, houses, . . .
- Estimating perimeters of simple shapes, in *turtle steps*.
- Drawing simple shapes or pictures requiring repeated patterns, using the REPEAT command.
- Predicting outcomes on the screen given a list of primitives.
- Debugging a list of primitives to produce a required shape or picture.

DERIVE (Computer Algebra Software)

Used appropriately, Derive can enhance the learning of algebra. At this stage it should not be used to bypass pencil and paper methods but rather to reinforce those methods. For example, to solve simple equations the SOLVE command should not be used and the *balance method* should be employed and reinforced.

The children should know how to

- Use the Author, Simplify Basic, Approximate and Substitute For commands.
- Use F3 and F4 to copy highlighted expressions when using the Author command.
- Edit expressions to correct mistakes or modify an expression.

CABRI GEOMETRY II (Dynamic Geometry Software)

Pupils should be given opportunities to use CABRI to explore, discover and establish geometrical results. The exploratory work on CABRI should be the basis of further work in the classroom.

The children should be given tasks that would enable them to learn know how to use the basic tools:

POINTER (Pointer)
POINTS (Point, Point on Object, Intersection Point)
LINES (Line, Segment, Ray, Triangle, Regular Polygon)
CURVES (Circle)

CONSTRUCT (Perpendicular Line, Parallel Line, Midpoint, Compass)
TRANSFORM (Rotation, Reflection, Symmetry)
MEASURE (Distance and Length, Area, Angle)
DISPLAY (Label, Mark Angle)
Optional: Any of the DRAW tools.

The children are expected to become familiar with the use of these tools in a natural way, through investigative tasks set by the teacher. Typical tasks include discovering: the angles' sum properties at a point and on a straight line; the relationship between angles associated with parallel lines; the construction of different types of triangles; the angles' sum property for any triangle; side, angle and symmetry properties, if any, of triangles, squares, rectangles and quadrilaterals.

The children should be encouraged to discuss, communicate and, whenever possible, explain their findings and record these in writing, by making use of the appropriate mathematical language.

FORM 2

Throughout the year children are expected to use EXCEL (a spreadsheet), LOGO (a programming language for children), DERIVE (Computer Algebra Software) and CABRI GEOMETRY II (Dynamic Geometry Software). The list outlined below gives an indication of what children are expected to know and do by the end of the year.

THE SPREADSHEET (EXCEL)

Children should be given opportunities to interact with pre-written spreadsheets to become familiar with the spreadsheet environment and to consolidate particular mathematical concepts. Gradually they should be given opportunities to learn how to

- Carry out simple calculations involving the four rules.
- Generate "function machines" (e.g. double a number and subtract 3 . . . =A1*2 – 3)
- Enter numerical data into the spreadsheet and analyze this data using the built in functions AVERAGE, MEDIAN, MODE, MAX, MIN.
- Construct simple bar charts and pie charts.

MICROWORLDS LOGO

Logo contributes a lot towards the mathematics curriculum. It is a highly enjoyable experience; it helps children develop mathematical concepts and skills; it enhances problem solving skills by encouraging them to think both algorithmically and procedurally; it gives rise to new learning and teaching styles, such as group work, investigative work and mathematical communication (with the computer and with class mates).

Children should be given opportunities to

- Use the basic Logo primitives encountered in Form 1
- Write simple procedures incorporating the Logo primitives. (e.g. To Square REPEAT 4 [FD 60 RT 90] END)
- Edit, save and load procedures.
- Document a procedure.

Typical activities using LOGO include:

- Write a procedure that will draw a particular given shape (e.g. square, rectangle, equilateral triangles)
- Debug a procedure until it draws the required shape.
- Predict what a given procedure will draw.
- Write procedures that draw parallelograms and rhombi given the sides and the included angle.

DERIVE (Computer Algebra Software)

Used appropriately, Derive can enhance the learning of algebra. At this stage it should not be used to bypass pencil and paper methods but rather to reinforce those methods. For example, to solve simple equations the SOLVE command should not be used and the *balance method* should be employed and reinforced.

Children should be given opportunities to

- Use the Author, Simplify Basic, Approximate and Substitute For commands.
- Use F3 and F4 to copy highlighted expressions when using the Author command.
- Edit expressions to correct mistakes or modify an expression.
- Carry out appropriate manipulations on expressions to change the subject of the formula.
- Construct a simple formula or equation from a word problem and use it to solve the problem.

- Author a set of ordered pairs of points, using AUTHOR MATRIX and plot these points in the PLOT WINDOW.
- Investigate different graphical relationships and interpret gradients and intercepts.
- Know how to view the ALGEBRA WINDOW and the PLOT WINDOW simultaneously or individually.
- Know how to adjust scales to obtain the desired graphical picture.

OPTIONAL: Know how to change the Plot Background, the colour of the Plots; know how to use other options related to the Plot Window.

CABRI GEOMETRY II (Dynamic Geometry Software)

Pupils should be given opportunities to use CABRI to explore, discover and establish geometrical results. The exploratory work on CABRI should be the basis of further work in the classroom.

The children should be given tasks that would enable them to consolidate the use of the basic tools encountered in Form 1 and use other new tools, namely:

LINES (Polygon)
CONSTRUCT (Perpendicular Bisector, Angle Bisector)
TRANSFORM (Translation)
MEASURE (Slope, Equation and Co-ordinates)
DRAW (Show/Hide Axes, New Axes, Define Grid)

The children may become acquainted with these tools in a natural way when teachers set tasks requiring their use. Typical tasks include: construction of lines, angles, parallels and perpendiculars; construction of particular angles; construction of the bisector of an angle; construction of the perpendicular bisector of a line; construction of the perpendicular to a line; compound constructions involving basic ones; discovering the relationship between the circumference and diameter of a circle to establish π; plotting points satisfying particular rules, drawing lines passing through these points, finding the slope of the line and confirming the equation of the line.

The children should be encouraged to discuss, communicate and, whenever possible, explain their findings and record these in writing, by making use of the appropriate mathematical language.

FORM 3

Throughout the year children are expected to use EXCEL (a spreadsheet), LOGO (a programming language for children), DERIVE (Computer Algebra Software) and CABRI GEOMETRY II (Dynamic Geometry Software). The list outlined below gives an indication of what children are expected to know and do by the end of the year.

THE SPREADSHEET (EXCEL)

Children should be given opportunities to interact with pre-written spreadsheets to become familiar with the spreadsheet environment and to consolidate particular mathematical concepts. Gradually they should be given opportunities to learn how to

- Consolidate previously acquired knowledge and skills associated with the spreadsheet
- Generate more complicated "function machines" (e.g. square a number, subtract 3 and divide the result by 5 . . . =(A1^2 – 3)/5)
- Carry out calculations involving percentages on a spreadsheet, for example, to model "what happens if . . ." situations
- Generate a set of ordered pairs linearly related and construct a scatter and line graph to display this linear relationship.

MICROWORLDS LOGO

Logo contributes a lot towards the mathematics curriculum. It is a highly enjoyable experience; it helps children develop mathematical concepts and skills; it enhances problem solving skills by encouraging them to think both algorithmically and procedurally; it gives rise to new learning and teaching styles, such as group work, investigative work and mathematical communication (with the computer and with class mates).

Children should be given opportunities to

- Revise and use the basic Logo primitives encountered in Form 1 and Form 2
- Write simple procedures incorporating the Logo primitives. (e.g. TO TRIANGLE REPEAT 3 [FD 100 RT 120] END)
- Write procedures that call other procedures
- Discover the "total trip" theorem (the sum of the exterior angles of a polygon is 360°)
- Edit, save and load procedures
- Document a procedure

Typical activities using LOGO include:

- Write a procedure that will draw a particular given shape (e.g. square, rectangle, equilateral triangle, regular polygon, circle)
- Write procedures that draw composite shapes.
- Debug a procedure until it draws the required shape.
- Predict what a given procedure will draw.

DERIVE (Computer Algebra Software)

Used appropriately, Derive can enhance the learning of algebra. At this stage it should not be used to bypass pencil and paper methods but rather to reinforce those methods. For example, to solve simple equations the SOLVE command should not be used and the *balance method* should be employed and reinforced.

Children should be given opportunities to

- Familiarize themselves with those facilities provided by the software they used in the previous two years.
- Use the EXPAND and FACTORISE features.
- Plot linear and quadratic graphs, observe their characteristic properties and deduce information from them.
- Solve linear simultaneous equations in the Algebra Window by the substitution method and interpret their solution.
- Solve linear simultaneous equations graphically, using the Plot Window and interpret their solution.
- Use the software as a problem solving tool.

OPTIONAL: Know how to change the Plot Background, the colour of the Plots; know how to use other options available for the Plot Window.

CABRI GEOMETRY II (Dynamic Geometry Software)

Pupils should be given opportunities to use CABRI to explore, discover and establish geometrical results. The exploratory work on CABRI should be the basis of further work in the classroom.

The children should be given tasks that would enable them to consolidate the use of the basic tools encountered in Form 1 and 2 and use other new features, namely:

CHECK PROPERTY (Collinear, Parallel, Perpendicular, Member)
DISPLAY (Comments, Numerical Edit)
DRAW (Thick, Dotted, Modify Appearance)

The children may become acquainted with these tools in a natural way when teachers set tasks requiring their use.
Typical tasks include: discovering and establishing the angle properties of a circle; establishing the sum of the interior and exterior angles of a polygon; discovering Pythagoras' Theorem; exploring the ratio sides in similar right angled triangles, leading to the three trigonometric ratios; determining angles of elevation and depression from constructed scale diagrams (e.g. to determine the height of a tree or an inaccessible object); consolidation of the concepts of gradient and intercept of a line; using the software as a problem solving tool.

The children should be given opportunities to discuss, communicate and, whenever possible, explain their findings and record these in writing, by making use of the appropriate mathematical language.

Form 4

Throughout the year children are expected to use EXCEL (a spreadsheet), LOGO (a programming language for children), DERIVE (Computer Algebra Software) and CABRI GEOMETRY II (Dynamic Geometry Software). The list outlined below gives an indication of what children are expected to know and do by the end of the year.

THE SPREADSHEET (EXCEL)

Students should be given opportunities to use the spreadsheet as a problem solving tool. They should be given tasks that would help them

- Consolidate previously acquired knowledge and skills associated with the spreadsheet
- Use the spreadsheet functions RAND(), INT, and IF to model and simulate real life situations
- Carry out purposeful enquiries to answer "what happens if . . ." type questions
- Carry out calculations involving percentages in real life contexts (e.g. related to tax, insurance, commission, simple and compound interest, exchange rates, etc.)
- Use INSERT NAME CREATE to create a variable, as a substitute to the usual cell referencing
- Generate a set of ordered pairs not linearly related and construct and interpret a scatter and a line graph to display this non-linear (e.g. quadratic) relationship.
- Solve quadratic equations by trial and improvement.
- Analyse data, draw histograms and interpret the results. (e.g. examination results)
- Use the spreadsheet as a problem solving tool.

MICROWORLDS LOGO

Logo contributes a lot towards the mathematics curriculum. It is a highly enjoyable experience; it helps children develop mathematical concepts and skills; it enhances problem solving skills by encouraging them to think both algorithmically and procedurally; it gives rise to new learning and teaching styles, such as group work, investigative work and mathematical communication (with the computer and with class mates).

Children should be given opportunities to

- Revise and use the basic Logo primitives encountered in Form 1, Form 2 and Form 3.
- Write procedures that make use of variable inputs

Typical activities involving LOGO include:

- Write a procedure that will accept one or more variables to draw, for example, regular polygons having a different number of sides and varying side lengths.
- Write procedures that perform simple transformations – reflection, enlargement, rotation and translation.
- Projects involving variables.

DERIVE (Computer Algebra Software)

Used appropriately, Derive can enhance the learning of algebra. At this stage it should not be used to bypass pencil and paper methods but rather to reinforce those methods.

Students should be given opportunities to

- Familiarize themselves with the software features they were exposed to during the previous three years.
- Use the correct procedures to change the subject of formulae.
- Use the FACTORISE feature to a) appreciate that factorization is the reverse process of expansion and b) to develop paper and pencil strategies that will enable them to factorise binomials and trinomials.
- Use the SOLVE feature to solve quadratic equations and appreciate that the algebraic solutions and the graphical solutions of a quadratic equation are identical.
- Plot linear and quadratic graphs, observe their characteristic properties and deduce information from them.
- Solve problems leading to quadratic equations.
- Solve simultaneously linear and quadratic equations graphically, using the Plot Window, and interpret the solutions.
- Use the software as a problem solving tool.

OPTIONAL: Know how to change the Plot Background, the colour of the Plots; know how to use other options available for the Plot Window.

CABRI GEOMETRY II (Dynamic Geometry Software)

Students should be given opportunities to use CABRI to explore, discover and establish geometrical results. The exploratory work on CABRI should be the basis of further work in the classroom.

The students should be given tasks that would enable them to consolidate the use of the basic tools encountered in Form 1, 2 and 3 and use other new features, namely:

POINTER (Rotate, Dilate, Rotate and Dilate)
TRANSFORM (Dilation)
MEASURE (Calculate, Tabulate)

The students may become acquainted with these tools in a natural way when teachers set tasks requiring their use.
Typical tasks include: appreciating the properties of congruent triangles; exploring properties of similar triangles; discovering the symmetry properties of the circle; using scale drawing to solve simple problems in 2-D; transformation activities; using the software as a problem solving tool.

The children should be given opportunities to discuss, communicate and, whenever possible, explain their findings and record these in writing, by making use of the appropriate mathematical language.

FORM 5

Throughout the year children are expected to use EXCEL (a spreadsheet), LOGO (a programming language for children), DERIVE (Computer Algebra Software) and CABRI GEOMETRY II (Dynamic Geometry Software). The list outlined below gives an indication of what children are expected to know and do by the end of the year.

THE SPREADSHEET (EXCEL)

Students should be given opportunities to use the spreadsheet as a problem solving tool. They should be given tasks that would help them

- Consolidate previously acquired knowledge and skills associated with the spreadsheet

- Model and simulate real life situations
- Carry out purposeful enquiries to answer "what happens if . . ." type questions
- Construct travel graphs and deduce information from them
- Find, by trial and improvement, approximate solutions of equations for which there is no simple method of solution
- Analyse data and draw histograms, cumulative frequency curves and box-plots
- Use the spreadsheet for modeling real-life situations and to solve problems.

MICROWORLDS LOGO

Logo contributes a lot towards the mathematics curriculum. It is a highly enjoyable experience; it helps children develop mathematical concepts and skills; it enhances problem solving skills by encouraging them to think both algorithmically and procedurally; it gives rise to new learning and teaching styles, such as group work, investigative work and mathematical communication (with the computer and with class mates).

Children should be given opportunities to

- Revise and use the basic Logo primitives encountered in Form 1, 2, 3 and 4.
- Write procedures that make use of variable inputs

Typical activities involving LOGO include projects involving variables.

DERIVE (Computer Algebra Software)

Used appropriately, Derive can enhance the learning of algebra. At this stage it should not be used to bypass pencil and paper methods but rather to reinforce those methods.

Students should be given opportunities to

- Familiarize themselves with the software features they were exposed to during the previous four years.
- Plot linear, quadratic, cubic and reciprocal functions.
- Find the approximate solutions of equations (e.g. $x^3 – x = 80$) graphically and algebraically.
- Solve simultaneous linear and quadratic equations, graphically and algebraically.
- Define FUNCTIONS, determine their inverses and compare their plots.
- Use the software as a general problem solving tool.

CABRI GEOMETRY II (Dynamic Geometry Software)

Students should be given opportunities to use CABRI to explore, discover and establish geometrical results. The exploratory work on CABRI should be the basis of further work in the classroom.

The students should be given tasks that would enable them to consolidate the use of the basic tools encountered in Form 1, 2 , 3 and 4 and use other new features, namely:

CONSTRUCT (Measurement Transfer, Locus)
CHECK PROPERTY (Collinear, Parallel, Perpendicular, Equidistant, Member)
Optional - DISPLAY (Comments, Numerical Edit, Fix/Free, Trace On/Off, Animation, Multiple Animation)

The students may become acquainted with these tools in a natural way when teachers set tasks requiring their use.

Typical tasks include: constructing loci in two dimensions, discovering the alternate segment property of the circle and using the software as a general problem solving tool.

The children should be given opportunities to discuss, communicate and, whenever possible, explain their findings and record these in writing, by making use of the appropriate mathematical language.

IMPLEMENTING THE MATHEMATICS SYLLABUS

The teaching and learning process must reflect that the following considerations are being taken into account:

TEACHING AND LEARNING MATHEMATICS

The quality of mathematics learning depends on the quality of the teaching. What students learn is a reflection of the learning experiences that teachers provide. On the other hand, teaching mathematics well is a complex task and no simple recipes for helping all students to learn are available. Nevertheless effective mathematics teaching requires a serious commitment to the development of students' understanding of mathematics. Effective teachers know how to ask exploratory questions to reveal what the students already know and plan and design appropriate tasks that build on that knowledge. They reflect on their practice and engage themselves in continuous self-improvement.

Teachers must also ensure that students learn mathematics with understanding in order to be able to apply procedures, concepts and processes effectively. Learning with understanding makes subsequent learning easier. Mathematics makes more sense and is easier to remember and to apply when students connect new knowledge to existing knowledge in meaningful ways. Besides, learning with understanding creates autonomous learners who can take control of their learning, become confident in their ability to tackle difficult problems, seek alternative solution methods and learn to persevere. Such learners develop a feeling of accomplishment and eventually a willingness to pursue further engagement with mathematics.

COMMUNICATION

Communication is a necessary component for learning, doing and understanding mathematics. Communication in mathematics means that one is able not only to use its vocabulary, notation and structure to express ideas and relationships but also to think and reason mathematically. In fact, communication is considered the means by which teachers and students can share the processes of learning, doing and understanding mathematics. Students should express their thinking and problem solving processes in both written and oral formats, allowing code-switching when necessary. The clarity and completeness of students' communication can indicate how well they understand the related mathematical concepts. Because teaching is communicating, teachers play a central role in fostering students' mathematical communication and understanding. Teachers should therefore provide students with opportunities to discuss mathematics, particularly during activities which involve exploration, conjecturing, analysis and application of mathematical ideas. This approach gives way to the most common pedagogy prevalent in most classes, namely that of "teaching by telling" and reinforces the alternative approach, that of "constructivist teaching". In constructivist teaching students construct new knowledge by connecting it with experience. Students should not be looked upon as empty vessels waiting to receive information but rather have a certain amount of stored knowledge which may be accessed and updated. Research has shown that students learn and retain more information when they are able to articulate what they

know to others. Of more benefit is social constructivism which recognizes that students are part of the learning communities in which language and meaning can be shared among peers and teachers. Social constructivism therefore provides a framework in which teachers can facilitate student communication and in which learning is both corporate and individual.

The ability to communicate mathematical ideas can be fostered if:

- Understanding of mathematics is developed through reflection and by organization and communication of ideas.
- Understandings and relationships between and among mathematical concepts, procedures and symbols are communicated in writing and speaking. This must be done at each stage of conceptual development, whether concrete, pictorial or abstract, and in every area of mathematics.
- Mathematical situations are represented or described in a variety of ways (e.g. verbal, concrete, pictorial, graphical, algebraic.)
- Positions on mathematical processes and solutions are defended through sound argument.
- The need for mathematical symbolism is demonstrated.
- The ability to read mathematics is emphasised.
- The ability to write mathematical problems from real-world situations is emphasised.
- Proper and precise mathematical vocabulary and notation is stressed.
- Communication skills are developed in small groups working together, through listening, exploring, questioning, discussing and summarizing.

PROBLEM SOLVING

Learning to solve problems is one of the principal reasons for studying Mathematics. Problem solving therefore is the heart of the mathematics curriculum. Consequently students should be capable of applying previously acquired knowledge to new and unfamiliar situations, to solve non-routine problems, to pose questions, to analyse situations, translate results and apply trial-and-error methods. Students should see alternative solutions to problems and be aware that a particular problem may have more than one solution. Many different activities, such as gathering data, exploring patterns, making and testing conjectures, and justifying conclusions through logical arguments, are necessary to develop the students' mathematical reasoning and ability to communicate about mathematics.

Problem Solving also develops critical thinking skills, particularly when:

- Checks for reasonableness and completeness of results form an integral part of the problem solving process. Incorrect solutions are analysed to identify common errors in the problem-solving process.
- Multi-step solutions and non-routine problems are posed on a regular basis.
- Activities that require collecting, organising, manipulating data and drawing inferences from that data are provided.
- Group problem solving is encouraged so that the students will be able to share responsibility for the product of the activity after having an opportunity to discuss the results.
- Activities are structured so that several strategies or techniques are available for use in the solution process.
- Inter-disciplinary projects are encouraged.

- Strategies such as top-down analysis and stepwise refinement are used to analyse and solve complex problems.

INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Calculators and computers are essential tools for teaching, learning and doing Mathematics. The potential that ICT has in making a significant contribution to pupils' learning in mathematics has already been referred to in Section 5 of this document and need not be amplified any further. However, as with any teaching tool, it can be used well or poorly. Teachers therefore have to select or create mathematical tasks that take advantage of what this new technology can do efficiently and well.

DIFFERENTIATED TEACHING

All students are entitled to learn Mathematics. To achieve this goal expectations for students' learning must be raised. Teachers are therefore required to develop effective methods to support the learning of mathematics by all students. This does not mean that every student should receive identical instruction; it means that reasonable and appropriate adjustments are made to promote access and attainment for all students.

Some students may need further support. For example, some students may benefit from oral rather than written assessments. Others need more time to complete certain tasks. Others may need additional resources and individual attention. Those students with special interests or exceptional talent in the subject may need enrichment material to challenge and engage them. The school must therefore take care to accommodate the special needs of some students without keeping back the learning of others by providing the necessary human and material resources.

NUMERACY

One of the outcomes of this curriculum is to produce citizens who have confidence and competence with numbers and measures. They should be able to understand the number system, possess a repertoire of computational skills and be capable of solving number problems in a variety of contexts. They should also be able to understand the ways in which information is gathered by counting and measuring and presented in the form of graphs, diagrams, charts and tables.

Students should therefore be provided with opportunities that help them

- acquire a feel for the size of a number and know where it fits into the number system
- recall number facts (number bonds, multiplication tables, doubles and halves)
- figure out answers mentally
- use a range of calculation strategies to calculate accurately and efficiently, both mentally and with pencil and paper

- appreciate when it is appropriate to use a calculator
- check whether their answers are reasonable by using different strategies
- make sensible estimates of measurements
- interpret graphs, diagrams, charts and tables and make predictions from the information these display.

ASSESSMENT

The purpose of assessment is not simply to certify the students' attainment at the end of a series of lessons. It also serves to inform teachers about their effectiveness. Consequently assessment can help teachers make important decisions regarding their teaching and eventually adjust their teaching to enhance the students' learning. Very often assessment is based on tests or homeworks. Although these do contribute towards assessment, they are not the only methods that can provide feedback. For example, through the use of good tasks involving investigative work the students' level of proficiency can be determined. Classroom discussions in which students present and evaluate different approaches to the solution of a complex problem may also be utilized to good effect. Other informal means, such as open-ended questions, performance tasks, observations and conversations, journals and portfolios, can also give the teacher information about the students' progress. All the feedback that the teacher acquires from these different forms of assessment can help the teacher to decide, for example, how and when to revisit a particular topic or how to adapt tasks for students who are either struggling or need enrichment or perhaps a challenge.

Formal assessments provide only one viewpoint on what students can do in a very particular situation. Excessive reliance on such assessments may give an incomplete and perhaps a distorted picture of the students' performance. Teachers need to be aware that different students show what they know and can do in different ways, so when various forms of assessment are used each student will be allowed to show his or her best strengths.

ANNUAL EXAMINATIONS

The Annual Examination will consist of two papers:

1. **Forms 1 to 3: A written non-calculator paper consisting of 10 questions to be answered in 10 minutes, carrying a total of 10 marks. Rulers, protractors and any other mathematical instruments will not be allowed.**
   Forms 4 and 5: A written non-calculator paper consisting of 20 questions to be answered in 20 minutes, carrying a total of 20 marks. Rulers, protractors and any other mathematical instruments will not be allowed.
   Questions will typically involve number calculations, approximations, estimations, data and graphical interpretations, application of formulae, recall and application of properties of shapes and recall and application of mathematical facts. To answer these questions, particularly those involving numerical calculations, students 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.

2. **Forms 1 to 3: A written calculator paper consisting of 15 questions to be answered in 1 h 50 min and carrying a total of 90 marks. Five questions will carry 4 marks each, another five questions will carry 6 marks each and the remaining five questions 8 marks each.**
   Forms 4 and 5: A written calculator paper consisting of not more than 13 questions with varying mark allocations to be answered in 1 h 40 min and carrying a total of 80 marks.
   Note:
   - **For Form 1 only - no calculators will be allowed.**
   - **Testing knowledge, skills and understanding, questions testing the use of ICT may also be set (e.g. to write down or complete a set of LOGO instructions to draw a rectangle.)**

The difficulty levels of the questions will be roughly set as follows: LOW 25 - 30%; MEDIUM 40 – 45%; HIGH 25 – 35%.