MINISTRY OF EDUCATION AND DEVELOPMENT

Department of Education

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BERMUDA PUBLIC SCHOOL SYSTEM
MATHEMATICS PERFORMANCE STANDARDS SUMMARY

MISSION STATEMENT

The mission of the Bermuda Public School System
is to be the 1st choice in education
by providing rigorous and stimulating learning experiences
in safe, responsive environments
from which our students emerge confident and prepared
to compete and contribute locally and globally.

November 2006

Quality Education for All

Mathematics (MT)

BERMUDA MATHEMATICS PERFORMANCE STANDARDS (MT)

Many of the elementary terms and concepts of mathematics have concrete applications and examples in the world. For they are part of a language developed to describe the physical (and social) world.

(Ernest, 1991, p.56)

"Improving mathematics education is not a matter of adding a little spice to a dull subject or of making a few minor changes in content or approach. It requires no less than a redefinition of mathematics (instruction) and an understanding that (its) goal must be the development of mathematical power in all students" (Parker, 1993, p. xi). From as early as preschool, we attempt to present the students with a balance of conceptual understanding, skills and problem solving. Mathematics is no longer viewed as the subject to be mastered by the chosen few. *Principles and Standards for School Mathematics*, published by the National Council of Teachers of Mathematics (NCTM 2000, p.4) states that the need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase. While some careers are considered mathematics intensive, all will require fundamental mathematical skills, procedures and understandings.

The *Bermuda Mathematics Performance Standards* were developed from standards defined by the *National Council of Teachers of Mathematics* and from various jurisdictions including the United Kingdom and Canada. The *Bermuda Mathematics Performance Standards* support the Bermuda Mathematics Curriculum. The curriculum identifies the distribution of mathematics content over a 14-year period. It advises when enduring understandings and procedural knowledge should be introduced, reinforced and/or developed. The *Standards* provide a framework for assessing the understandings and applications of essential mathematical ideas, that is, what students should know and be able to do. The assessment indicators listed in the *Standards* define the critical elements of the mathematics programme that will be formally assessed at the end of each year level from Primary 3 through Senior 2. The assessment instruments will be comprised of selected- and constructed-response items with an emphasis on reasoning and problem solving. Students will be required to produce evidence that they are able to use, represent and explain the fundamental components of the mathematics programme. The *Standards* include these conceptual areas:

NUMBER AND NUMBER OPERATIONS (N)

A sense of number implies an ability to describe and apply relationships among numbers including their uses and their representations. These numbers are effectively used for various purposes such as counting, measuring, estimating and problem solving. A range of methods of computation is applied to practical tasks, in real-life situations and within mathematics itself.

N1. **Numerical Representation -** The positions of the digits in numbers determine what they represent, that is, which size group they count, measure or order and these numbers are best understood in terms of familiar real-world experiences, such as budgeting, cooking, carpentry, etc.

N2. **Numerical Operations -** Numerical operations consist of taking apart and combining numbers using a variety of strategies which require an understanding of the properties of the operations. Manipulatives and diagrams are used to model these operations and their inverses and to relate them to their symbolic expressions. The mathematical models or representations are also used to assist with solving contextual problems.

N3. **Numerical Relationships -** Equal shares or equal-sized portions of a whole or unit are compared using a variety of representations. Fractions, decimals and percents can be used interchangeably and equivalent fractions are ways of describing the same amount by using different-sized fractional parts. Ratio and proportion are used to represent relationships between quantities and measures as applied in problem solving

PATTERNS, FUNCTIONS AND ALGEBRA (A)

The generalization of patterns, relationships and change are expressed by means of symbolic notation, algebraic equations and graphical representations. Reasoning is used to generalize, formalize and communicate patterns and regularity in all aspects of mathematics.

A1. **Patterns and Functions -** Patterns are regular and predictable changes. They are found in nature, and numbers, as well as in physical and geometrical situations. Patterns show relationships among variables and can be recognized, extended or generalized.

A2. **Algebraic Representation -** Symbols are used to represent variables and equations. They assist us with understanding the patterns and relationships among forms of representations - words, tables, graphs and rules. Variables are symbols used to represent quantities that change - time, temperature, distance traveled.

A3. **Algebraic Reasoning** consists of a variety of formats used to assist with understanding, justifying or presenting solutions to problems. Equations and inequalities are used to express the relationships.

GEOMETRY (G)

Spatial sense involves the application of the properties and relationships of points, lines, angles, planes and curves of shapes and solids. The space around us and the measurement of the objects and shapes in that space are defined and categorized according to a specific set of assumptions.

G1. **Classification -** Both two-dimensional and three-dimensional shapes can be described, analysed and classified in a variety of ways and according to their properties and relationships.

G2. **Spatial Reasoning -** Geometric properties, reasoning and visualization can be used to solve problems.

G3. **Transformations -** Draw shapes and build models

MEASUREMENT (M)

Measuring requires the use of tools and units to determine, describe and compare attributes. These measurements encompass the dimensions, size, quantity, length, or capacity of substances or figures as well as sequential relationships such as time and temperature.

M1. **Tools and Units -** Standard mathematical measurement tools and units depend on the real world situation.

M2. **Measuring -** The comparison of an item with a unit (length, time, volume, etc.)

DATA HANDLING (D)

Data may be presented in a variety of representations including graphs to show logical relationships between various quantities and to assist with decision-making. The collection and analysis of data is identified as either statistics or probability. Statistics is the mathematics used for collecting, organizing, and studying data while probability is the measure of the likelihood of an event.

D1. **Data Collection and Organization -** Data are collected and organised to help with the making of decisions, the drawing of inferences or the development of new ideas.

D2. **Representation -** Appropriate representations of data depend on characteristics of that data.

D3. **Analysis and Interpretation -** Provides information on the attributes of data

D4. **Probability -** The occurrence or non-occurrence of an event is characterized as impossible, less likely, equally likely, more likely or certain. The likelihood of an event or its probability is quoted as a ratio between 0 and 1 inclusive.

Mathematics processes are the means by which students use mathematical ideas and procedures to communicate, represent, connect, reason and solve problems. These skills assist in the acquisition of knowledge and the application of ideas. Students are required to use a variety of techniques to understand and solve problems, reason and construct proofs as well as communicate and make connections. They express and extend their mathematical ideas using correct notations, generalizations, inferences and rigorous arguments leading to notions of proof. The solutions involve a process as well as a product.

The use of mathematical process skills are categorized as follows:

1. **Mathematical processes are used to identify and explain everyday experiences, in and outside of school, and to make connections with other disciplines.**

a) use reasoning ability to analyze, perceive patterns, identify relationships and formulate questions for further exploration
b) formulate a problem and set limits for acceptable solutions

2. **Mathematical reasoning and problem solving provide a means for making sense of, investigating, evaluating and justifying the solution to problems.**

a) systematically apply a model (plan) for problem solving - *understand the problem, select a strategy, implement the strategy, evaluate the solution.*
b) select or develop an appropriate problem-solving strategy
c) analyze problems using appropriate processes such as modelling, simplifying, generalizing, etc
d) validate conclusions using mathematical properties and relationships

3. Appropriate mathematical representations and technology tools are used to illustrate and assist with the solution process.

a) determine the most efficient manner to solve problems
b) design representations of the problem using technology and appropriate mathematical discourse (terminology, symbols and drawings)
c) select mathematical ideas and tools to support the reasoning process

4. **Ideas and solutions are communicated mathematically using language and symbols, efficient tools, appropriate units and graphical, numerical, physical or algebraic models.**

a) communicate logical arguments clearly to show why the solution makes sense

Using the *Standards* as a framework, the assessment results will provide teachers with information on how well the students perform procedures, understand concepts, solve problems and communicate their reasoning. Administrators will be able to analyze and compare data to ascertain trends in student performance over time. The *Bermuda Mathematics Performance Standards* define the framework for assessing the depth and breadth our students are engaging in mathematical thinking and are confidently using quantitative and spatial information to make decisions.

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MATHEMATICS (MT) PERFORMANCE STANDARDS
for
NUMBER AND NUMBER OPERATIONS (N)

Number and Number Operations (N)
A sense of number implies an ability to describe and apply relationships among numbers, their uses and their representations. These numbers are effectively used for various purposes such as counting, measuring, estimating and problem solving. A range of methods of computation is applied to practical tasks, in real-life situations and within mathematics itself.

Students will explore and make sense of the meaning, relationship and application of numbers, number systems and number operations. They will extend their estimation and computation skills, develop procedural fluency and represent their conceptual understanding using words, formulas, diagrams, charts and graphs.

	MT.P3.N	MT.P4.N	MT.P5.N	MT.P6.N	MT.M1.N	MT.M2.N	MT.M3.N	MT.S1.N	MT.S2.N
Numerical Representation	***Students will demonstrate an understanding of numbers, by using, representing and explaining. They will:***								
1. The positions of the digits in numbers determine what they represent, that is, which size group they count, measure or order and these numbers are best understood in terms of familiar real-world experiences, such as budgeting, cooking, carpentry, etc.	a) compare and order whole numbers up to 1000 b) represent whole numbers with • *number lines and other pictorial models* • *verbal descriptions* • *symbolic renaming (e.g. 25 = 20 + 5 = 10 + 15)* c) identify and use place value through hundreds d) name the whole number immediately before or after any 2-digit number e) apply cardinal numbers up to 1000 in quantifying and measuring objects f) use ordinal numbers up to thirty-first in identifying the order of objects g) identify even and odd numbers	a) compare and order numbers ($0.1 < n < 10{,}000$) b) identify place value up to 10,000 c) represent numbers with • *number lines* • *verbal descriptions* • *symbolic renaming (e.g. 333 = 300 + 30 + 3 = 300 + 20 + 13)* d) apply the properties of the special numbers, 0 and 1	a) compare and order numbers $0.01 < n < 100{,}000$) b) identify place value up to 100,000 c) apply equivalent representations of the same number and generate them by decomposing and composing numbers including expanded notation d) know and apply the properties of the special numbers, 0 and 1	a) compare and order numbers ($0.001 < n < 1{,}000{,}000$) b) identify place value up to 1,000,000 c) apply equivalent representations of the same number and generate them by decomposing and composing numbers including expanded notation d) know and apply the properties of special numbers, 0 and 1	a) apply equivalent representations of the same number and generate them by decomposing and composing numbers including expanded notation (1,023,000 = 1,000,000 + 20,000 + 3000) b) represent and use whole numbers, integers, fractions, decimals, percents and exponentials *(scientific notation)* in a variety of equivalent forms in real world and problem situations c) understand that numbers and their negatives are at equal distance from 0 on a number line d) know and apply the properties of special numbers, 0 and 1 e) apply in context the concept of negative numbers (e.g. temperature)	a) understand and apply the relationship between squares and square roots b) represent and use whole numbers, integers, fractions, decimals, percents and exponentials *(scientific notation)* in a variety of equivalent forms in real world and problem situations c) add and subtract negative rational number d) know and apply the properties of special numbers, 0 and 1,	a) understand and apply the relationship between squares and square roots to solve problems b) represent and use whole numbers, integers, fractions, decimals, percents and exponentials *(scientific notation)* in a variety of equivalent forms in real world and problem situations c) multiply and divide negative rational numbers d) know and apply the properties of special numbers, 0, 1 and π	a) understand and apply the relationship between squares and square roots and cubes and cube roots to solve problems b) represent and use whole numbers, integers and exponentials in a variety of equivalent forms including in real world and problem situations *(also scientific notation)* c) add, subtract, multiply and divide negative rational numbers d) know and apply the properties of special numbers, 0, 1 and π	a) understand and apply the relationship between squares and square roots and cubes and cube roots to solve problems b) represent and use whole numbers, integers and exponentials in a variety of equivalent forms including in real world and problem situations c) know and apply the properties of special numbers, 0, 1 and π

Number and Number Operations (N)	MT.P3.N	MT.P4.N	MT.P5.N	MT.P6.N	MT.M1.N	MT.M2.N	MT.M3.N	MT.S1.N	MT.S2.N
Numerical Operations	***Students will demonstrate an understanding of number, by using, representing and explaining. They will:***								
2. Numerical operations consist of taking apart and combining numbers using a variety of strategies which require an understanding of the properties of the operations. Manipulatives and diagrams are used to model these operations and their inverses and to relate them to their symbolic expressions. The mathematical models or representations are also used to assist with solving contextual problems.	a) add and subtract 2-digit numbers with regrouping b) apply multiplication facts relating to the 2s, 5s, 10s c) use multiplication and division to solve real life problems involving equal groupings of objects and sharing equally d) apply appropriate computational procedures in problem-solving situations (involving whole numbers) such as: • *estimation* • *selecting and applying algorithms for addition, subtraction and multiplication* e) check answers and explain whether numerical solutions are reasonable Constructed Response (CR)	a) estimate by rounding numbers less than 1000 to the nearest 10 or 100 b) apply the four operations (with regrouping) and the relationship between them to problem solving *Assessment limits:* – *add 4-digit numbers (2 addends)* – *subtract 4-digit numbers* – *multiply using facts up to 9 X 9* – *multiply a 2-digit number by a 2-digit number* – *divide using facts up to 9 X 9* – *test for divisibility for 2, 5, 10* c) use a variety of methods to check results and to determine reasonableness of the solution, including estimation and inverse operations (CR) d) apply appropriate problem solving strategies	a) estimate by rounding numbers (no more than 2 decimals) to the nearest integer b) apply the four operations and the relationship between them to problem solving *Assessments limits:* – *multiplication facts to 12 X 12* – *multiply 2 and 3 digit numbers by a 2-digit number* – *divide a 3-digit number by a 1-digit number with remainders* – *divide by multiples of 10* – *test for divisibility for 3, 6, 9* c) understand and use the inverse relationship between addition and subtraction d) use a variety of methods to check results and to determine reasonableness of the solution, including estimation and inverse operations e) apply appropriate problem solving strategies	a) apply estimation strategies and identify when an estimate is more appropriate than an exact answer b) apply the four operations and the relationship between them to problem solving c) understand and use the inverse relationship between multiplication and division d) use a variety of methods to check results and to determine reasonableness of the solution, including estimation and inverse operations e) apply order of operations to positive rational numbers (2 operations with or without brackets f) apply number theory concepts (prime and composite, factors, multiples, odd numbers, divisibility – 4 & 8) in real world and mathematical problem situations (CR) g) apply appropriate problem solving strategies	a) apply the four operations and the relationship between them to problem solving b) apply properties of operations including order of operations to positive rational numbers c) apply number theory concepts (factors, multiples, odd numbers, divisibility) in real-world problem situations d) apply the inverse relationship between addition/ subtraction and multiplication/ division e) use a variety of methods to check results and to determine reasonableness of the solution (CR) f) apply estimation strategies and identify when an estimate is more appropriate than an exact answer g) apply appropriate problem solving strategies	a) apply the four operations and the relationship between them to problem solving b) apply properties of operations including order of operations c) apply the inverse relationship between addition/subtraction and multiplication/division d) use a variety of methods to check results and to determine reasonableness of the solution (CR) e) apply estimation strategies and identify when an estimate is more appropriate than an exact answer f) apply appropriate problem-solving strategies	a) apply the four operations and the relationship between them to problem solving b) apply properties of operations including order of operations c) understand and use the inverse relationship between exponents and roots d) use a variety of methods to check results and to determine reasonableness of the solution, including estimation and inverse operations (CR) e) apply estimation strategies and identify when an estimate is more appropriate than an exact answer f) apply appropriate problem solving strategies	a) use the calculator functions such as memory, constant and brackets to solve a problem and evaluate expressions (CR) b) use a variety of methods to check results and to determine reasonableness of the solution, including estimation and inverse operations (CR)	a) use the calculator functions such as memory, constant and brackets to solve a problem and evaluate expressions (CR) b) understand and use the inverse relationship between exponents and roots c) use a variety of methods to check results and to determine reasonableness of the solution, including estimation and inverse operations (CR) d) apply operations using rational numbers

Number and Number Operations (N)	MT.P3.N	MT.P4.N	MT.P5.N	MT.P6.N	MT.M1.N	MT.M2.N	MT.M3.N	MT.S1.N	MT.S2.N
Numerical Relationships	***Students will demonstrate an understanding of numbers, by using, representing and explaining. They will:***								
3. Equal shares or equal-sized portions of a whole or unit are compared using a variety of representations. Fractions, decimals and percents can be used interchangeably and equivalent fractions are ways of describing the same amount by using different-sized fractional parts. Ratio and proportion are used to represent relationships between quantities and measures as applied in problem solving.	a) recognize and use in context simple fractions (e.g., halves, fourths, tenths) b) determine the value of a collection of coins up to $1 (Bermuda coins)	a) add and subtract simple common fractions with like denominators b) identify fractions as part of a whole c) represent equal fractions with different denominators (using pictures) d) add and subtract decimal fractions in the context of money	a) add, subtract and multiply common fractions with unlike denominators b) add, subtract and multiply decimal fractions c) apply the relative magnitude and relationship among whole numbers, fractions, decimals and mixed numbers d) apply proportional comparisons of fractions and decimals in the context of everyday situations	a) apply the equivalency of fractions to analyze and solve problems b) find fractions of quantities c) order rational numbers and represent them as fractions or terminating decimals where possible and translate between these representations d) apply proportional comparisons of fractions, decimals and percentages (multiples of 10 up to 50%) in the context of everyday situations	a) use the relative magnitude and relationship among whole numbers, fractions, decimals and mixed numbers (e.g., which is larger?) b) order rational numbers and represent them as fractions or terminating decimals where possible and translate between these representations c) apply proportional comparisons of fractions, decimals and percentages in the context of everyday situations d) solve percent problems of the form *a% of b* equals *c* for any one of the variables *a, b, or c*	a) use the relative magnitude and relationship among whole numbers, fractions, decimals and mixed numbers b) solve percent problems of the form *a% of b* equals c for any one of the variables *a, b, or c* c) solve problems involving rates of change (e.g., speed, density) d) apply the relationships and applications of ratio, proportion and percentage (gratuity [tip 15%], customs duty [25%], payroll tax [4.75%], discounts [5% grocery shopping])	a) use the relative magnitude and relationship among whole numbers, fractions, decimals and mixed numbers b) solve simple proportion problems using such methods as unit rate, scaling and finding the proportion equation a/b = c/d c) apply the relationships and applications of ratio, proportion and percentage (gratuity/tip [15%], customs duty [25%], payroll tax [4.75%], discounts [5% grocery shopping])	a) apply fractions, decimals, and percents in a variety of equivalent forms including in real world and problem situations b) solve simple proportion problems using such methods as unit rate, scaling and finding the proportion equation a/b = c/d c) apply the relationships and applications of ratio, proportion and percentage (gratuity/tip [15%], customs duty [25%] on all items purchased outside of Bermuda, payroll tax [4.75%], discounts [5% grocery shopping], and simple interest])	a) apply fractions, decimals and percents in a variety of equivalent forms in real world and problem situations (including compound interest) b) use direct and inverse proportion to solve problems set in context

MATHEMATICS (MT) PERFORMANCE STANDARDS
for
PATTERNS, FUNCTIONS AND ALGEBRA (A)

Patterns, Functions and Algebra (A)
The generalization of patterns, relationships and change is expressed by means of symbolic notation, algebraic equations and graphical representations. Reasoning is used to generalise, formalise and communicate patterns and regularity in all aspects of mathematics.

Students will explore and make sense of patterns, functions, symbols and models. They will use symbolic forms to represent and analyze mathematical situations and use mathematical models to analyze change in both real and abstract contexts. Students will create and translate multiple representations of mathematical relationships.

	MT.P3.A	MT.P4.A	MT.P5.A	MT.P6.A	MT.M1.A	MT.M2.A	MT.M3.A	MT.S1.A	MT.S2.A
Patterns and Functions	***Students will demonstrate an understanding of algebra, by using, representing and explaining. They will:***								
1. Patterns are regular and predictable changes. They are found in nature, and numbers, as well as in physical and geometrical situations. Patterns show relationships among variables and can be recognized, extended or generalized.	a) make predictions and extend numeric and geometric patterns b) describe a pattern using pictures or words	a) make predictions and extend numeric and geometric patterns b) represent and describe patterns with symbolic rules or words	a) create and extend geometric and numeric patterns b) represent and describe patterns with tables, pictures, symbolic rules or words (e.g., add 2 or + 2)	a) create and extend geometric and numeric patterns b) represent and describe patterns with tables, pictures, symbolic rules or words c) explain how a change in one variable affects the change in another variable such as, Area of rectangle =bh (e.g., Area of a rectangle is 24 with length = 4 and width = 6. If the length is doubled and the area stays the same, what will be the new width?) (CR) d) justify predictions about patterns (CR)	a) analyse and create patterns and functions to represent and solve problems b) apply the basic concept of a function, that is, how change in one quantity or variable results in changes in another (perimeter-side relationship for a square)	a) analyse and create patterns, functions and graphs to represent and solve problems b) apply and explain simple functions (area-side relationship for a square) c) use different methods of presenting a pattern (sequences, tables, graphs, verbal rules, open sentences, equations) d) analyze functional relationships to explain how a change in one quantity results in a change in another (CR)	a) analyse and create patterns, functions and graphs to represent and solve problems b) compare properties of linear functions between or among tables, graphs and equations c) explain how change in one variable affects the change in another variable, such as, C = ∏d, Area of triangle = ½bh or if speed remains constant, an increase in time results in an increase in distance (CR)	a) generalise and extend patterns represented graphically or numerically with words or symbolic rules b) analyze and create patterns, functions and graphs to represent and solve problems c) use and interpret formulas to answer questions about quantities and their relationships d) compare properties of linear functions between or among tables, graphs and equations e) analyse the nature of change (including slope and intercepts) in quantities in linear relationships	a) analyse and extend patterns represented graphically or numerically b) identify values of functions and use them in applications, e.g., real-world phenomena involving growth and decay c) perform operations on functions d) use slope to show rate of change in linear functions arising from real-world situations

Patterns, Functions and Algebra (A)	MT.P3.A	MT.P4.A	MT.P5.A	MT.P6.A	MT.M1.A	MT.M2.A	MT.M3.A	MT.S1.A	MT.S2.A
Algebraic Representation	***Students will demonstrate an understanding of algebra by using, representing and explaining. They will:***								
2. Symbols are used to represent variables and equations. They assist us with understanding the patterns and relationships among forms of representations - words, tables, graphs and rules. Variables are symbols used to represent quantities that change - time, temperature, distance traveled.	a) use symbols to represent simple numerical situations (addition/subtraction number sentences, i.e. 3 + [box] = 7)	a) use symbols to represent numerical situations (multiplication)	a) use symbols to represent numerical situations (multiplication and division) and simple formulas (e.g., the perimeter of a square) b) illustrate how a change in one variable affects a second variable (CR)	a) use symbols to represent patterns in relationship to real world situations (e.g., A = 17n for A the number of apples in 17 boxes containing n apples each) b) graph ordered pairs on a positive coordinate grid	a) use symbols to represent patterns in relationship to real world situations (e.g., **c** = **t**/10 for **c** the cost of a movie theatre ticket and **t** the total amount paid for 10 persons) b) graph ordered pairs on a positive coordinate grid	a) represent situations as algebraic expressions b) add and subtract simple algebraic expressions of the first degree including integer coefficients c) combine like terms and substitute for unknowns in a given expression d) graph ordered pairs in all quadrants	a) add, subtract and multiply simple algebraic expressions b) represent mathematical expressions and relationships through numbers and symbols, such as (5x + 3) and 4(y + 1) c) graph ordered pairs in all quadrants d) analyze the nature of change in quantities in linear relationships (e.g., slope and intercepts)	a) apply mathematical relationships expressed as numbers and symbols b) factor polynomials (e.g., $3a - 9$; $a^2 - 9$) c) multiply and divide expressions with positive exponents/indices/ powers d) interpret negative and fractional exponents (e.g., x^{-1} and $27^{⅔}$ e) apply basic algebraic operations, such as, combining like terms, expanding and substituting for unknowns f) graph ordered pairs on a coordinate grid	a) apply mathematical relationships expressed as words, numbers and symbols b) factor polynomial expressions including trinomials *(coefficient of x^2 = 1)* c) add, subtract and multiply simple algebraic expressions including binomial multiplication d) write equations for linear graphs (i.e., given two points, write the equation of the line) e) use tables and graphs to models the relationships between two real-world quantities (e.g., the relationship between British pounds and Bermuda dollars) f) evaluate algebraic expressions, including substitution

Patterns, Functions and Algebra (A)	MT.P3.A	MT.P4.A	MT.P5.A	MT.P6.A	MT.M1.A	MT.M2.A	MT.M3.A	MT.S1.	MT.S2.
Algebraic Reasoning	***Students will demonstrate an understanding of algebra, by using, representing and explaining. They will:***								
3. Algebraic reasoning consists of a variety of formats used to assist with understanding, justifying or presenting solutions to problems. Equations and inequalities are used to express the relationships.	a) find solutions to number sentences with a missing value (addition and subtraction) b) model and solve problems related to patterns and relationships using objects and tables	a) find solutions to number sentences with a missing value (multiplication) b) model and solve problem situations using objects and tables (example)	a) find solutions to number sentences with a missing value (division) b) model and solve problem situations using objects and tables (example)	a) solve linear equations using concrete models, tables and paper-pencil methods b) model and solve problem situations using objects, graphs and tables (e.g., Given a table of hours and wages earned, how long will it take to earn x amount?) c) find and explain solutions to number sentences with a missing value (CR)	a) model and solve problems set in their natural context using representations such as patterns, graphs, tables and equations	a) model and solve problems set in their natural context using representations such as patterns, graphs, tables and equations b) solve two-step linear equations	a) model and solve problems set in their natural context using representations such as patterns, graphs, tables and equations b) solve two-step linear equations c) model inequalities concretely, pictorially (e.g., graphs and tables) and abstractly	a) model and solve problems set in their natural context using representations such as patterns, graphs, tables and equations b) solve linear equations with unknowns on both sides including fractions c) model inequalities concretely (e.g., algebra tiles) and pictorially (e.g., graphs and tables) and abstractly d) solve linear equations and simple systems of equations (set in context) and interpret their solution(s)	a) model and solve problems set in their natural context using representations such as patterns, graphs, tables and equations b) solve linear equations with unknowns on both sides and with brackets c) solve linear inequalities d) solve systems of linear equations (two equations in two variables), including systems that arise from real-world problems using symbolic and graphical methods e) determine solutions to quadratic equations

MATHEMATICS (MT) PERFORMANCE STANDARDS
for
GEOMETRY (G)

Geometry (G)
Spatial sense involves the application of the properties and relationships of points, lines, angles, planes and curves of shapes and solids. The space around us and the measurement of the objects and shapes in that space are defined and categorized according to a specific set of assumptions.

Students will use a variety of techniques, tools and formulas to analyze characteristics and properties of two- and three-dimensional geometric objects; apply coordinate geometry and graph theory; and solve problems using visualization and spatial reasoning.

	MT.P3.G	MT.P4.G	MT.P5.G	MT.P6.G	MT.M1.G	MT.M2.G	MT.M3.G	MT.S1.G	MT.S2.G
Classification	***Students will demonstrate an understanding of geometry by using, representing and explaining. They will:***								
1. Both two-dimensional and three-dimensional shapes can be described, analysed and classified in a variety of ways and according to their properties and relationships.	a) recognise and name two-dimensional shapes b) classify two-dimensional shapes according to their properties c) recognise three-dimensional objects (spheres, cuboids) d) recognise and create shapes that have symmetry	a) name two-dimensional shapes (circle, polygons up to eight sides) b) identify the attributes of three-dimensional objects and of solids using formal geometric vocabulary (sphere, cuboids, cone, cylinder) c) identify lines (horizontal, vertical) and angles (acute, right) d) identify lines of symmetry in pictures and plane figures e) identify and describe the results of reflections (flips)	a) name the different quadrilaterals b) identify and classify three-dimensional shapes according to their attributes c) identify lines (parallel, perpendicular) and angles (straight, obtuse) d) identify and describe lines of symmetry in plane shapes e) identify and describe the results of reflections (flips) and translations (slides) f) identify and describe congruent shapes	a) classify and describe two-dimensional shapes (polygons up to eight sides) and three-dimensional objects according to their attributes b) identify line segments and angles c) identify the parts of a circle (radius, diameter, circumference) d) identify lines of symmetry in plane figures e) identify and describe the results of reflections (flips), translations (slides) and rotations (turns)	a) classify and describe planes and solids according to their attributes b) measure (to plus or minus one degree) angles and classify them	a) identify lines, angles and parts of a circle (arc, sector) b) classify triangles according to their properties	a) identify lines, angles and parts) of a circle (chord, segment, tangent) b) classify quadrilaterals according to their properties	a) solve problems using geometric properties b) apply the angle and line properties of a circle • *angles at the centre of a circle* • *angles standing on the same arc* c) classify and analyse similar and congruent triangles d) describe geometric properties and relationships (slope, intercept, parallelism, perpendicularity) using the coordinate system	a) solve triangles using geometric properties (Pythagoras' Theorem, trigonometric ratios) b) apply the angle and line properties of a circle • *angles at the centre of the circle* • *angles standing on the same arc* c) classify and analyse similar and congruent triangles d) describe and characterise geometric properties and relationships (slope, intercept, parallelism, perpendicularity) using the coordinate system e) perform calculations and simple proofs using lines and angles

Geometry (G)	MT.P3.G	MT.P4.G	MT.P5.G	MT.P6.G	MT.M1.G	MT.M2.G	MT.M3.G	MT.S1.G	MT.S2.G
Spatial Reasoning	***Students will demonstrate an understanding of geometry by using, representing and explaining. They will:***								
2. Geometric properties, reasoning and visualization can be used to solve problems.	a) solve problems related to two-dimensional shapes b) identify new shapes made by cutting shapes apart and putting shapes together c) describe the similarities and differences of two shapes or of two solids	a) solve problems related to two-dimensional shapes and three-dimensional objects b) solve problems using congruency (rectangles) c) classify two-dimensional shapes according to their properties	a) solve problems related to two-dimensional shapes and three-dimensional objects b) solve problems using congruency (rectangles, triangles)	a) solve problems related to two-dimensional shapes and three-dimensional objects b) solve problems using congruency and similarity (rectangles, triangles, combination of both)	a) use the properties of two- and three-dimensional shapes to solve mathematical and real-world problems b) apply the angle sum of a triangle c) estimate the size of an angle with reference to benchmark angles d) identify flat patterns (nets) that represent cuboids (rectangular prisms)	a) use the properties of two- and three-dimensional shapes to solve mathematical and real-world problems b) apply the relationship between the number of sides and the sums of the angle measures of polygons c) determine the size of angles formed by intersecting lines d) identify flat patterns (nets) that represent cuboids (rectangular prisms)	a) use the properties of two- and three-dimensional shapes to solve mathematical and real-world problems (give example) b) apply the relationship between the number of sides and the sums of the angle measures of polygons c) determine the size of angles formed by parallel lines and the transversal d) identify flat patterns (nets) that represent triangular prisms and cylinders e) classify figures in terms of congruence and similarity and apply these relationships to the solution of problems. f) apply the Pythagorean Theorem	a) solve real world problems using geometric models b) determine lengths of sides and measures of angles using trigonometric ratios (sine, cosine, tangent) c) solve real-world problems using the Pythagorean Theorem	a) demonstrate an understanding of the three ratios used in right-angled triangle trigonometry (sine, cosine, tangent) b) solve real-world problems using right-angled triangle trigonometry and the Pythagorean Theorem (angles of elevation and depression)

Geometry (G)	MT.P3.G	MT.P4.G	MT.P5.G	MT.P6.G	MT.M1.G	MT.M2.G	MT.M3.G	MT.S1.G	MT.S2.G
Transformations	***Students will demonstrate an understanding of geometry by using, representing and explaining. They will:***								
3. Draw shapes and build models.	a) visualize and describe the results of combining two or more shapes b) identify and construct congruent shapes	a) draw and classify two-dimensional shapes b) visualize and describe the results of combining three-dimensional objects (sphere, cuboids, cone, cylinder) c) reflect (flip) plane figures	a) draw and classify triangles, quadrilaterals and polygons b) visualize and describe the results of combining three-dimensional objects (sphere, cuboids, cone, cylinder, pyramid) c) reflect (flip) and translate (slide) plane figures d) locate or plot on a map using cardinal (N,E,S,W) directions	a) construct circles b) visualize and describe the results of combining and sub-dividing three-dimensional objects (sphere, cuboids, cone, cylinder, pyramid) c) reflect (flip), translate (slide) and rotate (turn) plane figures d) locate or plot a point on a map using cardinal (N,E,S,W) and intermediate (NE,SE,SW,NW) directions	a) predict and describe the result of the reflection and rotation (90, 180, clockwise) of a plane figure on a coordinate grid	a) predict and describe the result of the translation of a plane figure on a coordinate grid	a) predict the results of transformations on the coordinate plane and draw the transformed figure b) use transformational geometry to describe motions, patterns, designs and properties of shapes in the real world (CR) c) use technology or other tools to formulate and test conjectures and to make geometric constructions (CR)	a) identify and describe the properties of figures by using appropriate transformations (translations, rotations, reflections, enlargements) b) build physical models and use them to describe the relationship among figures and the relationship among their parts (CR) c) draw shapes concisely using appropriate tools (CR)	a) analyse the properties of figures by using appropriate transformations (translations, rotations, reflections, enlargements) b) build physical models and use them to analyse the relationship among figures and the relationship among their parts (CR) c) draw shapes concisely using appropriate tools (CR)

MATHEMATICS (MT) PERFORMANCE STANDARDS
for
MEASUREMENT (M)

Measurement (M)
Measuring requires the use of tools and units to determine, describe and compare attributes. These measurements encompass the dimensions, size, quantity, length or capacity of substances or figures as well as sequential relationships such as time and temperature.

Students will use a variety of techniques, tools and formulae to determine the dimensions or the capacity of shapes and figures. Students will understand the systems of units for measuring perimeter, area and volume and will understand how to measure the volume and surface area of solid figures.

	MT.P3.M	MT.P4.M	MT.P5.M	MT.P6.M	MT.M1.M	MT.M2.M	MT.M3.M	MT.S1.M	MT.S2.M
Tools and Units	***Students will demonstrate an understanding of measurement by using, representing and explaining. They will:***								
1. Standard mathematical measurement tools and units depend on the real world situation.	a) identify the appropriate tool for measuring length, time and temperature b) identify units to measure length (inches, cm)	a) identify the appropriate tools for measuring length and weight b) identify the appropriate units for measuring length and weight	a) identify the appropriate measurement tools to find length, perimeter, weight, time and temperature b) convert units within a system (time [hours, minutes], money)	a) convert linear units within a system of measurement (feet, inches, mm, cm, dm, m) b) convert units of time (hours, minutes, seconds) c) select and use appropriate tools and units to measure to a level of accuracy required in a particular setting	a) select appropriate tools and units to measure to a level of accuracy required in a particular setting b) convert units, within the same measurement system, to solve problems (linear, capacity) (Provide conversions)	a) select appropriate tools and units to measure to a level of accuracy required in a particular setting b) describe how a change in one measure affects the others (use a visual aid) (e.g., Area of a rectangle is 24 sq. units. The length is 4 and the width is 6. If the length is doubled and the area stays the same, what will be the new width?)	a) select appropriate tools and units to measure to a level of accuracy required in a particular setting b) describe how a change in one measure affects the others (e.g., Area of a rectangle is 24 sq. units. The length is 6 and the width is 4. If the length is increased by 2 and the area stays the same, what will be the new perimeter?)	a) justify the use of various systems of measurement and be proficient in the conversion of units within the same system (CR) b) select the appropriate units which must be used to solve measurement problems	a) justify the use of various systems of measurement and be proficient in the conversion of units within the same system (CR) b) select the appropriate tools and units to solve measurement problems

Measurement (M)	MT.P3.M	MT.P4.M	MT.P5.M	MT.P6.M	MT.M1.M	MT.M2.M	MT.M3.M	MT.S1.M	MT.S2.M
Measuring	***Students will demonstrate an understanding of measurement by using, representing and explaining. They will:***								
2. The comparison of an item with a unit (length, time, volume, etc.).	a) identify the attributes of length and weight (metric and customary) b) know the attributes of time (analogue) (include telling the time to the hour and the half hour) c) use measurement to describe and compare these attributes (length, time) d) describe relationships among various standard units for measuring length (inches, cm) e) order events using a calendar (find dates) Assessment limits: • days • weeks • months f) order events in pictorial form (e.g. getting dressed to go outside)	a) show measurement ideas using manipulatives, like paper clips, diagrams, and written symbols b) find surface area using counting methods (grid, colour tiles) c) tell time to the minute using both analogue and digital clocks d) use money in real life situations to estimate, count, record collections, and to make change up to $10 e) solve real world problems (e.g., measure with a ruler in one-inch and half-inch intervals)	a) find the perimeter and area of a rectangle. (provide formulae, use grids) b) determine the relationship between perimeter and area of a rectangle c) read and write time to the minute using both analogue and digital clocks d) solve real world problems (e.g., measure with a ruler in one-inch, half-inch and quarter-inch intervals)	a) find the perimeter and area of rectangles, triangles and combinations of both b) compare perimeter and area when a two dimensional shape is changed (rectangles, triangles) Provide formulae and a diagram c) compare and order events according to the duration of time (years, decade, century) d) solve real world problems (e.g. measure in increments of one inch, half inch, quarter inch and eighth inch intervals)	a) estimate measurement and determine the level of accuracy b) find the volume of a cuboid (rectangular prism) c) determine relationships amongst length, area, and volume d) find angle measure, weight, capacity, time and temperature from pictures using scales, protractors, clocks etc. (appropriate units required) e) determine elapsed time f) solve problems using measurement tools and concepts	a) compute the circumference and the area of a circle. Provide formulae b) solve problems including the volume of a cuboid (rectangular prism) c) solve problems using measurement tools and concepts	a) find the surface area of cuboids (rectangular prisms) and cylinders b) compute the volumes of cuboids (rectangular prisms, triangular prisms and cylinders (provide formulae) c) solve problems using measurement tools and concepts (use complex figures e.g., subdividing)	a) solve problems based on perimeter, area (include trapezoid) and volume using both standard and metric units b) explain how a change in one or more dimensions of a geometric shape affects perimeter, area, volume and surface area (CR) c) calculate the volumes and surface area of rectangular prisms, pyramids, cylinders, cones and spheres (provide formulae) d) use proportion to solve measurement problems (give similar figures) e) use formulae to solve problems involving speed, distance and time	a) solve problems based on perimeter, area and volume using both standard and metric units b) calculate the volumes and surface areas of rectangular prisms, pyramids, cylinders, cones and spheres in problem setting context (provide formulae) c) solve problems using measurement tools and concepts (e.g., Given a diagram drawn to scale, i.e., ¼ inch represents 1 foot, use the information to calculate the actual length)

MATHEMATICS (MT) PERFORMANCE STANDARDS
for
DATA HANDLING (D)

Data Handling (D)
Data may be presented in a variety of representations, including graphs to show logical relationships between various quantities and to assist with decision-making. The collection and analysis of data is identified as either statistics or probability. Statistics is the mathematics used for collecting, organizing, and studying data while probability is the measure of the likelihood of an event.

Mathematics instruction will include data analysis, statistics and probability. Students will be given the opportunity to pose questions and collect, organize, represent and interpret data to answer those questions; develop and evaluate predictions and arguments that are based on data; and apply basic notions of chance and probability. Students will use technology tools to investigate large samples, explore graphical representations and simulate events.

	MT.P3.D	MT.P4.D	MT.P5.D	MT.P6.D	MT.M1.D	MT.M2.D	MT.M3.D	MT.S1.D	MT.S2.D
Data Collection and Organisation	***Students will demonstrate an understanding of data handling by using, representing and explaining. They will:***								
1. Data are collected and organised to help with the making of decisions, the drawing of inferences or the development of new ideas.	a) collect and organise data using pictures, tallies and simple tables (CR)	a) collect and organise data (CR)	a) collect and organise data (CR)	a) collect and organise data (CR)	a) create and implement a plan for collection of data when given a problem situation (CR) b) organise data (CR)	a) create and implement a plan for collection of data when given a problem situation (CR) b) organise data (CR), including sampling methods	a) create and implement a plan for collection of data when given a problem situation (CR) b) organise data (CR), include sampling methods	a) collect, and organise, real-world data (include sampling methods) (CR) b) design and execute surveys or experiments, gather data to answer questions and communicate the results using traditional methods and technology (CR) c) construct frequency tables using ungrouped data (CR)	a) collect and organize real-world data (CR) b) organise and describe distributions of data by using a number of different methods including tables, histograms, bar graphs etc., (CR) c) design and execute surveys or experiments, gather data to answer questions and communicate the results using traditional methods and technology (CR)
Data Handling (D)	**MT.P3.D**	**MT.P4.D**	**MT.P5.D**	**MT.P6.D**	**MT.M1.D**	**MT.M2.D**	**MT.M3.D**	**MT.S1.D**	**MT.S2.D**
Representation	***Students will demonstrate an understanding of data handling by using, representing and explaining. They will:***								
2. Appropriate representations of data depend on characteristics of that data.	a) create pictographs and bar graphs from the data collected	d) create tally charts, pictographs and bar graphs	a) compare different graphical representations for the same set of data (tables, bar graphs, pictographs)	a) display data in a variety of forms (tables, bar graphs, line graphs) b) compare and contrast graphical representations of the same data	a) create or choose a variety of data representations (double bar graphs, pie charts)	a) create or choose a variety of data representations (line graphs)	a) create or choose a variety of data representations	a) represent and display data (graphs, tables, histograms, etc.)	a) recognise the appropriateness of the representation of data b) represent and display data

Data Handling (D)	MT.P3.D	MT.P4.D	MT.P5.D	MT.P6.D	MT.M1.D	MT.M2.D	MT.M3.D	MT.S1.D	MT.S2.D
Analysis and interpretation	***Students will demonstrate an understanding of data handling by using, representing and explaining. They will:***								
3. Provides information on the attributes of data.	a) interpret pictographs and bar charts (each symbol represents one thing) b) use data to solve a new problem	a) read and interpret tables and graphs to solve problems (bars must hit a line; complete symbols only; each symbol may represent 1, 2, 5, 10 things; no jumps on the scale) b) use data to solve problems	a) analyse and interpret data presented in a graph (pictographs – include ½ symbols; bar graphs - bars can go between lines; scales can jump) b) use data to solve problems	a) analyse data represented in a graph (double bar graphs, simple pie charts – ½, ¼, 1/8) b) make predictions based on data and communicate the reasoning (CR) c) use data to solve problems	a) read and interpret line graphs and pie charts	a) study data to make predictions and draw conclusions (double bar graphs, pie charts) b) compare related data sets c) find measure of central tendency (mean, median, mode and range) to describe a set of data	a) study data to make predictions and draw conclusions (pie charts, line graphs) b) compare related data sets c) find and select the appropriate measure of central tendency (mean, mode, median and range) to describe a set of data for a particular purpose	d) apply mean, median and mode to solve problems e) analyse interpret and use data for a data display	a) analyse data using mean, mode, median and range b) identify which measure of central tendency is most appropriate in a given situation c) analyse, interpret and use data from a data display

Data Handling (D)	MT.P3.D	MT.P4.D	MT.P5.D	MT.P6.D	MT.M1.D	MT.M2.D	MT.M3.D	MT.S1.D	MT.S2.D
Probability	***Students will demonstrate an understanding of data handling by using, representing and explaining. They will:***								
4. The occurrence or non-occurrence of an event is characterized as impossible, less likely, equally likely, more likely or certain. The likelihood of an event or its probability is quoted as a ratio between 0 and 1 inclusive.	a) use data to describe an event as more likely or less likely	a. use the data to describe an event as more likely, less likely or equally likely	a) list all possible outcomes of a probability experiment	a) state the outcome of simple experiments (spinners, number cubes, cards)	a) determine the probability of a simple event (including lists, tree diagrams or constructing a sample space involving all possible results)	a) determine the probability of a simple event b) use theoretical probabilities and experimental results to make predictions and decisions	a) determine whether or not an event is equally likely or if a game or process is fair b) find the probability of compound events (dependent and independent) (e.g., selection of an item with or without replacement)	a) find the probability of dependent and independent events b) design and use experimental and theoretical probability to represent and solve problems (include the "Fundamental Counting Principle")	a) find combinations and permutations in problem situations b) find the probability of dependent and independent events