
PURE MATHEMATICS 10–20–30

PROGRAM RATIONALE AND PHILOSOPHY

Pure mathematics emphasizes mathematical theory and the testing of mathematical hypotheses. The pure mathematics approach, which is often deductive and symbolic, endeavours to show that concepts are valid all the time, or valid within a well-defined set of restrictions. Real-life problems are then presented in order for students to apply previously learned mathematical concepts and procedures. Students will make use of algebra and graphing to solve problems. Algebra is taught both on a “when needed basis” and for its own sake.

Students are required to demonstrate effective communication skills. This includes understanding, using and interpreting various mathematical concepts and processes. When accomplishing program or curriculum outcomes, students will be expected to explain, to illustrate, to reason and to make connections. Multiple solution strategies to problems and problem contexts will be expected as students work through both routine and nonroutine problems.

Students will be expected to take responsibility for their learning as they work both independently and in groups. Tasks vary from short procedural items, which help students develop skills in the language of mathematics, to longer tasks that require students to test either subtle conjectures or apply mathematical knowledge to nonroutine, real-life problems.

Technology is a part of pure mathematics. The graphing calculator is the primary technological tool used by students for mathematical exploration, modelling and problem solving. The use of spreadsheets, with functions defined by the student, can be profitable in many contexts.

The Pure Mathematics 10–20–30 program is made up of outcomes, some of which are common to both the pure and applied mathematics programs. The approach to the common outcomes varies from the pure to the applied programs, but the critical skill of using mathematics to find solutions to real-life situations is developed in both programs.

LEARNER OUTCOMES

The general outcomes for the complete Pure Mathematics 10–20–30 program are shown first. The general outcomes are arranged in order of strand and substrand, following the order—Number, Patterns and Relations, Shape and Space, Statistics and Probability—established in *The Common Curriculum Framework for K–12 Mathematics Grade 10 to Grade 12: Western Canadian Protocol for Collaboration in Basic Education*, 1996. This listing is not intended as a sequence for instruction, and the number of outcomes is not an indication of the relative time to be spent on each of the strands. For each of the three courses, the learner outcomes follow the format of general outcomes and specific outcomes. The specific outcomes are arranged according to topics and in the order followed in the companion documents, *Outcomes with Assessment Standards for Pure Mathematics 10*, *Outcomes with Assessment Standards for Pure Mathematics 20* and the *Diploma Examination Bulletin for Pure Mathematics 30*.

MATHEMATICAL PROCESSES

There are critical components that students must encounter in a mathematics program in order to achieve the goals of mathematics education and to encourage lifelong learning in mathematics.

Each specific outcome incorporates one or more of these seven interrelated mathematical processes that are intended to permeate teaching and learning.

- *Communication* [C] – communicate mathematically
- *Connections* [CN] – connect mathematical ideas to other concepts in mathematics, to everyday experiences and to other disciplines
- *Estimation and Mental Mathematics* [E] – use estimation and mental mathematics where appropriate
- *Problem Solving* [PS] – relate and apply new mathematical knowledge through problem solving
- *Reasoning* [R] – reason and justify thinking
- *Technology* [T] – select and use appropriate technologies as tools to solve problems
- *Visualization* [V] – use visualization to assist in processing information, making connections and solving problems

GENERAL OUTCOMES—Number Strand

Substrand	Pure Mathematics 10–20–30
<p>Number Concepts (NC) <i>Students will:</i></p> <ul style="list-style-type: none"> • use numbers to describe quantities • represent numbers in multiple ways. 	<p>Analyze the numerical data in a table for trends, patterns and interrelationships. [Pure Mathematics 10]</p> <p>Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system. [Pure Mathematics 10]</p>
<p>Number Operations (NO) <i>Students will:</i></p> <ul style="list-style-type: none"> • demonstrate an understanding of and proficiency with calculations • decide which arithmetic operation or operations can be used to solve a problem, and then solve the problem. 	<p>Use basic arithmetic operations on real numbers to solve problems. [Pure Mathematics 10]</p> <p>Describe and apply arithmetic operations on tables to solve problems, using technology as required. [Pure Mathematics 10]</p> <p>Use exact values, arithmetic operations and algebraic operations on real numbers to solve problems. [Pure Mathematics 10]</p> <p>Solve consumer problems, using arithmetic operations. [Pure Mathematics 20]</p>

GENERAL OUTCOMES—Patterns and Relations Strand

Substrand	Pure Mathematics 10–20–30
<p>Patterns (P) <i>Students will:</i></p> <ul style="list-style-type: none"> use patterns to describe the world and to solve problems. 	<p>Generate and analyze number patterns. [Pure Mathematics 10]</p> <p>Apply the principles of mathematical reasoning to solve problems and to justify solutions. [Pure Mathematics 20]</p> <p>Generate and analyze exponential patterns. [Pure Mathematics 30]</p>
<p>Variables and Equations (VE) <i>Students will:</i></p> <ul style="list-style-type: none"> represent algebraic expressions in multiple ways. 	<p>Generalize operations on polynomials to include rational expressions. [Pure Mathematics 10]</p> <p>Represent and analyze situations that involve expressions, equations and inequalities. [Pure Mathematics 20]</p> <p>Solve exponential, logarithmic and trigonometric equations and identities. [Pure Mathematics 30]</p>
<p>Relations and Functions (RF) <i>Students will:</i></p> <ul style="list-style-type: none"> use algebraic and graphical models to generalize patterns, make predictions and solve problems. 	<p>Examine the nature of relations with an emphasis on functions. [Pure Mathematics 10 and 20]</p> <p>Represent data, using linear function models. [Pure Mathematics 10]</p> <p>Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate. [Pure Mathematics 20]</p> <p>Represent and analyze exponential and logarithmic functions, using technology as appropriate. [Pure Mathematics 30]</p> <p>Represent and analyze trigonometric functions, using technology as appropriate. [Pure Mathematics 30]</p>

GENERAL OUTCOMES—Shape and Space Strand

Substrand	Pure Mathematics 10–20–30
<p>Measurement (M) <i>Students will:</i></p> <ul style="list-style-type: none"> describe and compare everyday phenomena, using either direct or indirect measurement. 	<p>Solve problems involving triangles, including those found in 3-D and 2-D applications. [Pure Mathematics 10]</p>
<p>3-D Objects and 2-D Shapes (3D) <i>Students will:</i></p> <ul style="list-style-type: none"> describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them. 	<p>Solve coordinate geometry problems involving lines and line segments. [Pure Mathematics 10]</p> <p>Solve coordinate geometry problems involving lines and line segments, and justify the solutions. [Pure Mathematics 20]</p> <p>Develop and apply the geometric properties of circles and polygons to solve problems. [Pure Mathematics 20]</p> <p>Classify conic sections, using their shapes and equations. [Pure Mathematics 30]</p>
<p>Transformations (TR) <i>Students will:</i></p> <ul style="list-style-type: none"> perform, analyze and create transformations. 	<p>Perform, analyze and create transformations of functions and relations that are described by equations or graphs. [Pure Mathematics 30]</p>

GENERAL OUTCOMES—Statistics and Probability Strand

Substrand	Pure Mathematics 10–20–30
<p>Data Analysis (DA) <i>Students will:</i></p> <ul style="list-style-type: none"> collect, display and analyze data to make predictions about a population. 	<p>Implement and analyze sampling procedures, and draw appropriate inferences from the data collected. [Pure Mathematics 10]</p>
<p>Chance and Uncertainty (CU) <i>Students will:</i></p> <ul style="list-style-type: none"> use experimental or theoretical probability to represent and solve problems involving uncertainty. 	<p>Use normal and binomial probability distributions to solve problems involving uncertainty. [Pure Mathematics 30]</p> <p>Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations. [Pure Mathematics 30]</p> <p>Model the probability of a compound event, and solve problems based on the combining of simpler probabilities. [Pure Mathematics 30]</p>

PURE MATHEMATICS 10

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
Mental Mathematics **V** Visualization

Topic 1: Sequences and Data Tables

General and Specific Outcomes	
General Outcomes	Specific Outcomes
Analyze the numerical data in a table for trends, patterns and interrelationships.	(NC) 1.1 Use words and algebraic expressions to describe the data and the interrelationships in a given table with rows that are not related recursively (not calculated from previous data). [C, CN]
	(NC) 1.2 Use words and algebraic expressions to describe the data and the interrelationships in a given table with rows that are related recursively (calculated from previous data). [C, CN]
Implement and analyze sampling procedures, and draw appropriate inferences from the data collected.	(DA) 1.3 Choose, justify and apply sampling techniques that will result in an appropriate, unbiased sample from a given population. [C, PS, R]
	(DA) 1.4 Defend or oppose inferences and generalizations about populations, based on data from samples. [C, PS, R]
Describe and apply arithmetic operations on tables to solve problems, using technology as required.	(NO) 1.5 Create and modify tables from both recursive and nonrecursive situations. [PS, T, V]
	(NO) 1.6 Use and modify a spreadsheet template to model recursive situations. [PS, T, V]

(continued)

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 1: Sequences and Data Tables (continued)

General and Specific Outcomes	
General Outcome	Specific Outcomes
Generate and analyze number patterns.	(P) 1.7 Generate number patterns exhibiting arithmetic growth. [E, R] (P) 1.8 Use expressions to represent general terms and sums for arithmetic growth, and apply these expressions to solve problems. [CN, PS, R, T] (P) 1.9 Generate number patterns exhibiting geometric growth. [E, R]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 2: Algebraic Expressions

General and Specific Outcomes	
General Outcome	Specific Outcomes
Generalize operations on polynomials to include rational expressions.	(VE) 2.1 Factor polynomial expressions of the form $ax^2 + bx + c$, and $a^2x^2 - b^2y^2$. [E]
	(VE) 2.2 Find the product of polynomials. [E, R]
	(VE) 2.3 Divide an integral polynomial by a binomial, and express the result in the forms: <ul style="list-style-type: none"> • $\frac{P}{D} = Q + \frac{R}{D}$ • $P = DQ + R$ • $P(x) = D(x)Q(x) + R$. [E, R]
	(VE) 2.4 Determine equivalent forms of single-variable rational expressions with polynomial numerators, and denominators that are monomials, binomials or trinomials that can be factored. [PS, R]
	(VE) 2.5 Determine the nonpermissible values for the variable in single-variable rational expressions. [C, CN]
	(VE) 2.6 Perform the operations of addition, subtraction, multiplication and division on single-variable rational expressions. [E, R]
	(VE) 2.7 Find and verify the solutions of rational equations that reduce to linear equations. [CN, PS]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 3: Line Segments and Graphs

General and Specific Outcomes	
General Outcomes	Specific Outcomes
<p>Examine the nature of relations with an emphasis on functions.</p> <p>Solve coordinate geometry problems involving lines and line segments.</p>	(RF) 3.1 Plot linear and nonlinear data, using appropriate scales. [C, V]
	(3D) 3.2 Solve problems involving distances between points in the coordinate plane. [PS, V]
	(3D) 3.3 Solve problems involving midpoints of line segments. [PS]
	(3D) 3.4 Solve problems involving rise, run and slope of line segments. [PS, V]
	(3D) 3.5 Determine the equation of a line, given information that uniquely determines the line. [PS, V]
	(3D) 3.6 Solve problems using slopes of: <ul style="list-style-type: none"> • parallel lines • perpendicular lines. [CN, PS, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 4: Relations and Functions

General and Specific Outcomes	
General Outcome	Specific Outcomes
Examine the nature of relations with an emphasis on functions.	(RF) 4.1 Represent data, using function models. [CN, PS, V]
	(RF) 4.2 Use a graphing tool to draw the graph of a function from its equation. [C, T, V]
	(RF) 4.3 Describe a function in terms of: <ul style="list-style-type: none"> • ordered pairs • a rule, in word or equation form • a graph. [C, CN, V]
	(RF) 4.4 Use function notation to evaluate and represent functions. [C, PS]
	(RF) 4.5 Determine the domain and range of a relation from its graph. [PS, V]
	(RF) 4.6 Determine the following characteristics of the graph of a linear function, given its equation: <ul style="list-style-type: none"> • intercepts • slope • domain • range. [PS, V]

(continued)

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 4: Relations and Functions (continued)

General and Specific Outcomes	
General Outcomes	Specific Outcomes
Represent data, using linear function models.	(RF) 4.7 Use direct variation, partial variation and arithmetic sequences as applications of linear functions. [CN, PS, V]
Generate and analyze number patterns.	(P) 4.8 Relate arithmetic sequences to linear functions defined over the natural numbers. [CN]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 5: Exponents and Radicals

General and Specific Outcomes	
General Outcomes	Specific Outcomes
Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system.	(NC) 5.1 Classify numbers as natural, whole, integer, rational or irrational, and show that these number sets are nested within the real number system. [C, R, V]
	(NC) 5.2 Use approximate representations of irrational numbers. [R, T]
Use basic arithmetic operations on real numbers to solve problems.	(NO) 5.3 Communicate a set of instructions used to solve an arithmetic problem. [C]
	(NO) 5.4 Perform arithmetic operations on irrational numbers, using appropriate decimal approximations. [E, T]
Use exact values, arithmetic operations and algebraic operations on real numbers to solve problems.	(NO) 5.5 Explain and apply the exponent laws for powers of numbers and for variables with rational exponents. [C, E]
	(NO) 5.6 Perform operations on irrational numbers of monomial and binomial form, using exact values. [E]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 6: Measurement and Trigonometry

General and Specific Outcomes	
General Outcome	Specific Outcomes
Solve problems involving triangles, including those found in 3-D and 2-D applications.	(M) 6.1 Solve problems involving two right triangles. [CN, PS, V]
	(M) 6.2 Extend the concepts of sine and cosine for angles from 0° to 180° . [R, T, V]
	(M) 6.3 Apply the sine and cosine laws, excluding the ambiguous case, to solve problems. [CN, PS, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

PURE MATHEMATICS 20

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
Mental Mathematics **V** Visualization

Topic 1: Linear and Nonlinear Systems

General and Specific Outcomes	
General Outcome	Specific Outcomes
Represent and analyze situations that involve expressions, equations and inequalities.	(VE) 1.1 Graph linear inequalities, in two variables. [PS, V]
	(VE) 1.2 Solve systems of linear equations, in two variables: <ul style="list-style-type: none"> • algebraically (elimination and substitution) • graphically. [CN, PS, T, V]
	(VE) 1.3 Determine the solution to a system of nonlinear equations, using technology as appropriate. [PS, T, V]
	(VE) 1.4 Solve systems of linear equations, in three variables: <ul style="list-style-type: none"> • algebraically • with technology. [CN, PS, T, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 2: Quadratic Functions and Equations

General and Specific Outcomes	
General Outcome	Specific Outcomes
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	(RF) 2.1 Determine the following characteristics of the graph of a quadratic function: <ul style="list-style-type: none"> • vertex • domain and range • axis of symmetry • intercepts. [C, PS, T, V]
	(RF) 2.2 Connect algebraic and graphical transformations of quadratic functions, using completing the square as required. [CN, T, V]
	(RF) 2.3 Model real-world situations, using quadratic functions. [CN, PS]
	(RF) 2.4 Solve quadratic equations, and relate the solutions to the zeros of a corresponding quadratic function, using: <ul style="list-style-type: none"> • factoring • the quadratic formula • graphing. [CN, E, T, V]
	(RF) 2.5 Determine the character of the real and non-real roots of a quadratic equation, using: <ul style="list-style-type: none"> • the discriminant in the quadratic formula • graphing. [C, R, T, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 3: Polynomial and Other Nonlinear Equations and Functions

General and Specific Outcomes	
General Outcomes	Specific Outcomes
Represent and analyze situations that involve expressions, equations and inequalities.	(VE) 3.1 Solve nonlinear equations: <ul style="list-style-type: none"> • by factoring • graphically. [CN, T, V]
	(VE) 3.2 Use the remainder theorem to evaluate polynomial expressions and the factor theorem to determine factors of polynomials. [E, PS, T]
Examine the nature of relations with an emphasis on functions.	(RF) 3.3 Perform operations on functions and compositions of functions. [CN, E, PS]
	(RF) 3.4 Determine the inverse of a function. [CN, R, V]
Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.	(RF) 3.5 Describe, graph and analyze polynomial and rational functions, using technology. [C, R, T, V]
	(RF) 3.6 Formulate and apply strategies to solve: <ul style="list-style-type: none"> • absolute value equations • radical equations • rational equations • quadratic inequalities • polynomial inequalities. [CN, R, T, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 4: Formal Reasoning

General and Specific Outcomes	
General Outcome	Specific Outcomes
Apply the principles of mathematical reasoning to solve problems and to justify solutions.	(P) 4.1 Differentiate between inductive and deductive reasoning. [CN, R]
	(P) 4.2 Explain and apply connecting words, such as “and”, “or” and “not”, to solve problems. [C, PS, R, V]
	(P) 4.3 Use examples and counterexamples to analyze conjectures. [CN, R]
	(P) 4.4 Distinguish between an “if–then” proposition, its converse and its contrapositive. [CN, R]
	(P) 4.5 Prove assertions in a variety of settings, using direct reasoning. [R]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 5: Circles and Coordinate Geometry

General and Specific Outcomes	
General Outcome	Specific Outcomes
Develop and apply the geometric properties of circles and polygons to solve problems.	(3D) 5.1 Use technology and measurement to confirm and apply the following properties to particular cases: <ul style="list-style-type: none"> • the perpendicular from the centre of a circle to a chord bisects the chord • the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc • the inscribed angles subtended by the same arc are congruent • the angle inscribed in a semicircle is a right angle • the opposite angles of a cyclic quadrilateral are supplementary • a tangent to a circle is perpendicular to the radius at the point of tangency • the tangent segments to a circle, from any external point, are congruent • the angle between a tangent and a chord is equal to the inscribed angle on the opposite side of the chord • the sum of the interior angles of an n-sided polygon is $(2n - 4)$ right angles. [PS, R, T, V]
	(3D) 5.2 Prove the following general properties, using established concepts and theorems: <ul style="list-style-type: none"> • the perpendicular bisector of a chord contains the centre of the circle • the angle inscribed in a semicircle is a right angle • the tangent segments to a circle from any external point are congruent. [PS, R, CN]
	(3D) 5.3 Solve problems, using a variety of circle properties and relevant trigonometric ratios, and justify the solution strategy used. [PS, R, V]

(continued)

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 5: Circles and Coordinate Geometry
(continued)

General and Specific Outcomes	
General Outcome	Specific Outcomes
Solve coordinate geometry problems involving lines and line segments, and justify the solutions.	(3D) 5.4 Solve problems involving distances between points and lines. [CN, PS, R]
	(3D) 5.5 Verify and prove assertions in plane geometry, using coordinate geometry and trigonometric ratios as necessary. [C, R, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication	PS Problem Solving
CN Connections	R Reasoning
E Estimation and Mental Mathematics	T Technology
	V Visualization

Topic 6: Finance

General and Specific Outcomes	
General Outcome	Specific Outcomes
Solve consumer problems, using arithmetic operations.	(NO) 6.1 Solve consumer problems, which may include examples such as: <ul style="list-style-type: none"> wages earned in various situations property taxation exchange rates. [CN, E, PS, R, T]
	(NO) 6.2 Reconcile financial statements, which may include: <ul style="list-style-type: none"> cheque books and bank statements credit card statements loan statements. [CN, PS, T]
	(NO) 6.3 Solve budget problems, using graphs and tables to communicate solutions. [C, PS, T, V]
	(NO) 6.4 Plot and describe financial data of exponential form. [C, T, V]
	(NO) 6.5 Solve investment and credit problems involving simple and compound interest. [CN, PS, T]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

PURE MATHEMATICS 30

- | | |
|---|---------------------------|
| C Communication | PS Problem Solving |
| CN Connections | R Reasoning |
| E Estimation and
Mental Mathematics | T Technology |
| | V Visualization |

Topic 1: Transformations of Functions

General and Specific Outcomes	
General Outcome	Specific Outcomes
Perform, analyze and create transformations of functions and relations that are described by equations or graphs.	(TR) 1.1 Describe how various translations of functions affect graphs and their related equations: <ul style="list-style-type: none"> • $y = f(x - h)$ • $y - k = f(x)$. [C, T, V]
	(TR) 1.2 Describe how various stretches of functions (compressions and expansions) affect graphs and their related equations: <ul style="list-style-type: none"> • $y = af(x)$ • $y = f(kx)$. [C, T, V]
	(TR) 1.3 Describe how reflections of functions in both axes and in the line $y = x$ affect graphs and their related equations: <ul style="list-style-type: none"> • $y = f(-x)$ • $y = -f(x)$ • $y = f^{-1}(x)$. [C, T, V]
	(TR) 1.4 Using the graph and/or the equation of $f(x)$, describe and sketch $\frac{1}{f(x)}$. [C, T, V]
	(TR) 1.5 Describe and perform single transformations and combinations of transformations on functions and relations. [C, T, V]

- NC** Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

- RF** Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

- TR** Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 2: Exponents, Logarithms and Geometric Series

General and Specific Outcomes	
General Outcomes	Specific Outcomes
Generate and analyze exponential patterns.	(P) 2.1 Derive and apply expressions to represent general terms and sums for geometric growth and to solve problems. [CN, R, T]
Solve exponential, logarithmic and trigonometric equations and identities.	(P) 2.2 Connect geometric sequences to exponential functions over the natural numbers. [E, R, V]
	(VE) 2.3 Solve exponential equations having bases that are powers of one another. [E, R]
	(VE) 2.4 Use the laws of exponents and logarithms to: <ul style="list-style-type: none"> • solve and verify exponential equations and identities • solve logarithmic equations • simplify logarithmic expressions. [R]

(continued)

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 2: Exponents, Logarithms and Geometric Series (continued)

General and Specific Outcomes	
General Outcome	Specific Outcomes
Represent and analyze exponential and logarithmic functions, using technology as appropriate.	(RF) 2.5 Graph and analyze an exponential function, using technology. [R, T, V]
	(RF) 2.6 Model, graph and apply exponential functions to solve problems. [PS, T, V]
	(RF) 2.7 Change functions from exponential form to logarithmic form and vice versa. [CN]
	(RF) 2.8 Use logarithms to model practical problems. [CN, PS, V]
	(RF) 2.9 Explain the relationship between the laws of logarithms and the laws of exponents. [C, T]
	(RF) 2.10 Graph and analyze logarithmic functions with and without technology. [R, T, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 3: Trigonometry

General and Specific Outcomes	
General Outcome	Specific Outcomes
Solve exponential, logarithmic and trigonometric equations and identities.	(VE) 3.1 Distinguish between degree and radian measure, and solve problems using both. [CN, E]
	(VE) 3.2 Determine the exact and the approximate values of trigonometric ratios for any multiples of 0° , 30° , 45° , 60° and 90° and 0 , $\frac{\pi}{6}$, $\frac{\pi}{4}$, $\frac{\pi}{3}$, $\frac{\pi}{2}$. [CN, E]
	(VE) 3.3 Solve first and second degree trigonometric equations over the domain $0 \leq \vartheta < 2\pi$ or the domain $0^\circ \leq \vartheta < 360^\circ$ <ul style="list-style-type: none"> • algebraically • graphically. [PS, T]
	(VE) 3.4 Determine the general solutions to trigonometric equations where the domain is the set of real numbers. [PS, T]
	(VE) 3.5 Verify trigonometric identities: <ul style="list-style-type: none"> • numerically for any particular case • algebraically for general cases • graphically. [PS, R, T, V]

(continued)

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 3: Trigonometry (continued)

General and Specific Outcomes	
General Outcome	Specific Outcomes
Represent and analyze trigonometric functions, using technology as appropriate.	(RF) 3.6 Describe sine, cosine and tangent as circular functions, with reference to the unit circle and an angle in standard position. [PS, R, V]
	(RF) 3.7 Use sum, difference and double angle identities for sine and cosine to verify and simplify trigonometric expressions. [R, T]
	(RF) 3.8 Draw (using technology), sketch and analyze the graphs of sine, cosine and tangent functions, for: <ul style="list-style-type: none"> • amplitude, if defined • period • domain and range • asymptotes, if any • behaviour under transformations. [CN, T, V]
	(RF) 3.9 Draw and sketch (using technology) and analyze the graphs of secant, cosecant and cotangent functions, for: <ul style="list-style-type: none"> • period • domain and range • asymptotes • behaviour under horizontal and vertical stretches. [CN, T, V]
	(RF) 3.10 Use sine and cosine functions to model and solve problems. [PS, R, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 4: Conic Sections

General and Specific Outcomes	
General Outcome	Specific Outcomes
Classify conic sections, using their shapes and equations.	(3D) 4.1 Classify conic sections according to shape. [C, R, V]
	(3D) 4.2 Classify conic sections according to a given equation in general or standard (completed square) form (vertical or horizontal axis of symmetry only). [CN, T, V]
	(3D) 4.3 Convert a given equation of a conic section from general to standard form and vice versa. [R, T]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 5: Permutations and Combinations

General and Specific Outcomes	
General Outcomes	Specific Outcomes
Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations.	(CU) 5.1 Use the fundamental counting principle to determine the number of different ways to perform multistep operations. [PS, R]
	(CU) 5.2 Determine the number of linear permutations of n objects taken r at a time, and use this to solve problems. [PS, R, V]
	(CU) 5.3 Determine the number of combinations of n distinguishable objects taken r at a time, and use this to solve problems. [PS, R, V]
	(CU) 5.4 Determine the number of pathways in a given simple pathway problem. [CN, PS, R, V]
	(CU) 5.5 Determine the number of pathways in a given compound pathway problem. [CN, PS, R, V]
	(CU) 5.6 Solve problems using the binomial theorem, where the exponent n belongs to the set of natural numbers. [CN, E, PS, V]
Model the probability of a compound event, and solve problems based on the combining of simpler probabilities.	(CU) 5.7 Solve probability problems using either permutations and combinations or the fundamental counting principle. [E, PS, R]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty

C Communication **PS** Problem Solving
CN Connections **R** Reasoning
E Estimation and **T** Technology
 Mental Mathematics **V** Visualization

Topic 6: Statistics

General and Specific Outcomes	
General Outcome	Specific Outcomes
Use normal and binomial probability distributions to solve problems involving uncertainty.	(CU) 6.1 Find the population standard deviation of a data set, using technology. [CN, E, T, V]
	(CU) 6.2 Solve probability problems, using the binomial distribution. [PS, R, T]
	(CU) 6.3 Use z-scores to solve problems related to the normal distribution. [PS, R, T, V]

NC Number Concepts
NO Number Operations
P Patterns
VE Variables and Equations

RF Relations and Functions
M Measurement
3D 3-D Objects and 2-D Shapes

TR Transformations
DA Data Analysis
CU Chance and Uncertainty