Grade 10 Introduction to Applied and Pre-Calculus Mathematics (20S)

Grade 10 Introduction to Applied and Pre-Calculus Mathematics (20S) is intended for students considering post-secondary studies that require a math prerequisite. This pathway provides students with the mathematical understanding and critical-thinking skills that have been identified for specific post-secondary programs of study. The topics studied form the foundation for topics to be studied in both Grade 11 Applied Mathematics and Grade 11 Pre-Calculus Mathematics.

Components of the curriculum are both context-driven and algebraic in nature. Students will engage in experiments and activities that include the use of technology, problem solving, mental mathematics, and theoretical mathematics to promote the development of mathematical skills. These experiences will provide opportunities for students to make connections between symbolic mathematical ideas and the world around us.

Assessment of Grade 10 Introduction to Applied and Pre-Calculus Mathematics should be a balance of assessment *for* learning, assessment *as* learning, and assessment *of* learning. Assessment tools used in Grade 10 Introduction to Applied and Pre-Calculus Mathematics should be varied and may include observation, homework, learning conversations or interviews, summative unit essays, demonstrations, presentations, performance tasks, learning logs, projects, investigations, reflective journals, portfolios, quizzes, tests, and examinations. An appropriately prepared portfolio requires a consistent effort throughout the school term and a commitment to completing quality work on a daily basis.

The learning outcomes are divided into three topics: Measurement; Algebra and Number; and Relations and Functions. For instructional purposes, the learning outcomes could be arranged into units. Learning outcomes from different topics could be taught in the same unit. Some learning outcomes may fit into multiple units, and parts of the outcome could be taught in one unit while the remaining parts can be taught later. Two possible sequences of the learning outcomes into units with suggested time allotments follow. These are not the only possibilities, but they will provide some direction for teachers for their first time through the course. The suggested time includes instructional and assessment time.

Regardless of the organization of the learning outcomes into units, students should constantly be looking for and be given opportunities to see connections between the various learning outcomes in Grade 10 Introduction to Applied and Pre-Calculus Mathematics.

Possibility 1			Possibility 2		
Unit	Learning Outcomes	Suggested Hours	Unit	Learning Outcomes	Suggested Hours
Linear Modelling	R1, R4, R5	15	Graphs and Relations	R1, R3, R4, R5	20
Number Sense	A1, A2	5	Number Sense	A1, A2, A3	10
Measurement	M1, M2, M3	20	Linear Measurement	M1, M2	15
Linear Functions	R2, R8	10	Trigonometry	M4	10
Algebra	A3, A4, A5	15	Relations and Functions	R2, R8	10
Coordinate Geometry	R3, R6, R10	15	Polynomials	A3, A4, A5	15
Trigonometry	M4	10	Coordinate Geometry	R3, R5, R6, R7, R10	20
Applications of Linear Functions	R1, R7, R9	20	Surface Area and Volume	M3	5
			Systems of Equations	R9	5
	Total	**110**		**Total**	**110**

General and Specific Learning Outcomes with Achievement Indicators by Course

Grade 10 – Introduction to Applied and Pre-Calculus Mathematics

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

	Strand: Measurement	**General Learning Outcome:** Develop spatial sense and proportional reasoning.
	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.M.1.	Solve problems that involve linear measurement, using ■ SI and imperial units of measure ■ estimation strategies ■ measurement strategies [ME, PS, V]	■ Provide referents for linear measurements, including millimetre, centimetre, metre, kilometre, inch, foot, yard, and mile, and explain the choices. ■ Compare SI and imperial units, using referents. ■ Estimate a linear measure, using a referent, and explain the process used. ■ Justify the choice of units used for determining a measurement in a problem-solving context. ■ Solve a contextual problem that involves linear measure, using instruments such as rulers, tape measures, trundel wheels, micrometers, or calipers. ■ Explain a personal strategy used to determine a linear measurement such as the circumference of a bottle, the length of a curve, or the perimeter of the base of an irregular 3-D object, and explain why it works.
10I.M.2.	Apply proportional reasoning to problems that involve conversions within and between SI and imperial units of measure. [C, ME, PS, T]	■ Explain how proportional reasoning can be used to convert a measurement within or between SI and imperial systems. ■ Solve a contextual problem that involves the conversion of units within or between SI and imperial systems. ■ Justify, using mental mathematics, the reasonableness of a solution to a conversion problem.

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

Strand: Measurement *(continued)*	**General Learning Outcome:** Develop spatial sense and proportional reasoning.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*

10I.M.3.	Solve problems, using SI and imperial units, that involve the surface area and volume of 3-D objects, including
	■ right cones
	■ right cylinders
	■ right prisms
	■ right pyramids
	■ spheres
	[CN, PS, R, T, V]
		■ Sketch a diagram to represent a problem that involves surface area or volume.
		■ Determine the surface area (may be expressed with scientific notation) of a right cone, right cylinder, right prism, right pyramid, or sphere, using an object or its labelled diagram.
		■ Determine the volume (may be expressed with scientific notation) of a right cone, right cylinder, right prism, right pyramid, or sphere, using an object or its labelled diagram.
		■ Determine an unknown dimension of a right cone, right cylinder, right prism, right pyramid, or sphere, given the object's surface area or volume and the remaining dimensions.
		■ Solve a contextual problem that involves surface area or volume, given a diagram of a composite 3-D object.
		■ Describe the relationship between the volumes of
		  ■ right cones and right cylinders with the same base and height
		  ■ right pyramids and right prisms with the same base and height

10I.M.4.	Develop and apply the primary trigonometric ratios (sine, cosine, tangent) to solve problems that involve right triangles. [C, CN, PS, R, T, V]	■ Explain the relationships between similar right triangles and the definitions of the primary trigonometric ratios. ■ Identify the hypotenuse of a right triangle and the opposite and adjacent sides for a given acute angle in the triangle. ■ Solve a problem that involves one or more right triangles by applying the primary trigonometric ratios or the Pythagorean theorem. ■ Solve a problem that involves direct and indirect measurement, using measurement instruments such as a clinometer or metre stick, the trigonometric ratios, or the Pythagorean theorem.

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[C]	Communication	**[PS]**	Problem Solving
[CN]	Connections	**[R]**	Reasoning
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		[V]	Visualization

Strand: Algebra and Number	**General Learning Outcome:** Develop algebraic reasoning and number sense.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.A.1.	Demonstrate an understanding of factors of whole numbers by determining ■ prime factors ■ greatest common factor ■ least common multiple ■ square root ■ cube root [CN, ME, R]	■ Determine the prime factors of a whole number. n Explain why the numbers 0 and 1 are special cases when doing prime factorization. ■ Determine, using a variety of strategies, the greatest common factor or least common multiple of a set of whole numbers, and explain the process. ■ Determine, concretely or pictorially, whether a whole number is a perfect square, a perfect cube, or neither. ■ Determine, using a variety of strategies, the square root of a perfect square, and explain the process. ■ Determine, using a variety of strategies, the cube root of a perfect cube, and explain the process. ■ Solve a problem that involves prime factors, greatest common factors, least common multiples, square roots, or cube roots.
10I.A.2.	Demonstrate an understanding of irrational numbers by ■ representing, identifying, and simplifying irrational numbers ■ ordering irrational numbers [CN, ME, R, V]	■ Sort a set of numbers into rational and irrational numbers. ■ Determine an approximate value of an irrational number. ■ Approximate the locations of irrational numbers on a horizontal or vertical number line, using a variety of strategies, and explain the reasoning. ■ Order a set of irrational numbers on a horizontal or vertical number line. ■ Express a radical as a mixed radical in simplest form (limited to numerical radicands). ■ Express a mixed radical as an entire radical (limited to numerical radicands). ■ Explain, using examples, the meaning of the index of a radical. ■ Represent, using a graphic organizer, the relationship among the subsets of the real numbers (natural, whole, integer, rational, irrational).

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[ME]	Mental Mathematics and Estimation	**[T]**	Technology
		[V]	Visualization

Strand: Algebra and Number *(continued)*	**General Learning Outcome:** Develop algebraic reasoning and number sense.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*

10I.A.3.	Demonstrate an understanding of powers with integral and rational exponents.
	[C, CN, PS, R]
	
	This learning outcome offers the opportunity to expose students to scientific notation.
		■ Explain, using patterns or exponent laws, why $x^{-n} = \frac{1}{x^n}, x \neq 0$
		■ Explain, using patterns, why $x^{\frac{1}{n}} = \sqrt[n]{x}, n \neq 0$
		■ Apply the exponent laws to expressions with rational or variable bases and integral or rational exponents, and explain the reasoning
		  ■ $(x^m)(x^n) = x^{m+n}$
		  ■ $x^m \div x^n = x^{m-n}, x \neq 0$
		  ■ $(x^m)^n = x^{mn}$
		  ■ $(xy)^m = x^m y^m$
		  ■ $\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}, y \neq 0$
		■ Express powers with rational exponents as radicals and vice versa.
		■ Solve a problem that involves exponent laws or radicals.
		■ Identify and correct errors in the simplification of an expression that involves powers.

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		[V]	Visualization

Strand: Algebra and Number *(continued)*	**General Learning Outcome:** Develop algebraic reasoning and number sense.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.A.4.	Demonstrate an understanding of the multiplication of polynomial expressions (limited to monomials, binomials, and trinomials), concretely, pictorially, and symbolically. [C, CN, R, V] It is intended that the emphasis of this learning outcome be on binomial-by-binomial multiplication, with extension to polynomial-by-polynomial to establish a general pattern for multiplication.	■ Model the multiplication of two binomials, concretely or pictorially, and record the process symbolically. ■ Relate the multiplication of two binomial expressions to an area model. ■ Explain, using examples, the relationship between the multiplication of binomials and the multiplication of two-digit numbers. ■ Verify a polynomial product by substituting numbers for the variables. ■ Multiply two polynomials symbolically, and combine like terms in the product. ■ Generalize and explain a strategy for multiplication of polynomials. ■ Identify and explain errors in a solution for a polynomial multiplication.
10I.A.5.	Demonstrate an understanding of common factors and trinomial factoring, concretely, pictorially, and symbolically. [C, CN, R, V]	■ Determine the common factors in the terms of a polynomial, and express the polynomial in factored form. ■ Model the factoring of a trinomial, concretely or pictorially, and record the process symbolically. ■ Factor a polynomial that is a difference of squares, and explain why it is a special case of factoring a trinomial of the form $ax^2 + bx + c = 0$ where $b = 0$ and $c < 0$. ■ Identify and explain errors in a polynomial factorization. ■ Factor a polynomial, and verify by multiplying the factors. ■ Explain, using examples, the relationship between multiplication and factoring of polynomials. ■ Generalize and explain strategies used to factor a trinomial. ■ Express a polynomial as a product of its factors.

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Strand: Relations and Functions	**General Learning Outcome:** Develop algebraic and graphical reasoning through the study of relations.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.R.1.	Interpret and explain the relationships among data, graphs, and contexts. [C, CN, R, T, V]	■ Graph, with or without technology, a set of data, and determine the restrictions on the domain and range. ■ Explain why data points should or should not be connected on the graph for a context. ■ Match corresponding representations of data, graphs, and contexts. ■ Describe a possible context for a given graph. ■ Sketch a possible graph for a context. ■ Describe the restrictions on the domain and range for a context.
10I.R.2.	Demonstrate an understanding of relations and functions. [C, R, V]	■ Explain, using examples, why some relations are not functions but all functions are relations. ■ Determine whether a set of ordered pairs represents a function. ■ Sort a set of graphs as functions or non-functions. ■ Generalize and explain rules for determining whether graphs and sets of ordered pairs represent functions. ■ Determine and express in a variety of ways the domain and range of a relation.
10I.R.3.	Demonstrate an understanding of slope with respect to ■ rise and run ■ line segments and lines ■ rate of change ■ parallel lines ■ perpendicular lines [PS, R, V]	■ Explain, using examples, slope as a rate of change. ■ Determine the slope of a line segment by measuring or calculating the rise and run. ■ Classify lines in a set as having positive or negative slopes. ■ Explain the meaning of the slope of a horizontal or vertical line. ■ Explain why the slope of a line can be determined by using any two points on that line. ■ Draw a line, given its slope and a point on the line. ■ Determine another point on a line, given the slope and a point on the line. ■ Generalize and apply a rule for determining whether two lines are parallel or perpendicular. ■ Solve a contextual problem involving slope.

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		[V]	Visualization

Strand: Relations and Functions *(continued)*	**General Learning Outcome:** Develop algebraic and graphical reasoning through the study of relations.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.R.4.	Describe and represent linear relations, using ■ words ■ ordered pairs ■ tables of values ■ graphs ■ equations [C, CN, R, V]	■ Identify independent and dependent variables in a context. ■ Determine and explain whether a graph represents a linear relation. ■ Determine and explain whether a context represents a linear relation. ■ Determine and explain whether a table of values or a set of ordered pairs represents a linear relation. ■ Draw a graph from a set of ordered pairs within a context, and determine whether the relationship between the variables is linear. ■ Determine and explain whether an equation represents a linear relation. ■ Match corresponding representations of linear relations.
10I.R.5.	Determine the characteristics of the graphs of linear relations, including the ■ intercepts ■ slope ■ domain ■ range [CN, PS, R, T, V]	■ Determine the intercepts of the graph of a linear relation, and state the intercepts as values or ordered pairs. ■ Determine the slope of the graph of a linear relation. ■ Determine the domain and range of the graph of a linear relation. ■ Sketch a linear relation that has one, two, or an infinite number of intercepts. ■ Match graphs to their corresponding slopes and *y*-intercepts. ■ Solve a contextual problem that involves intercepts, slope, domain, or range of a linear relation.

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		[V]	Visualization

Strand: Relations and Functions *(continued)*	**General Learning Outcome:** Develop algebraic and graphical reasoning through the study of relations.

	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.R.6.	Relate linear relations expressed in ■ slope–intercept form ($y = mx + b$) ■ general form ($Ax + By + C = 0$) ■ slope–point form ($y - y_1 = m(x - x_1)$) to their graphs. [C, CN, R, T, V]	■ Express a linear relation in different forms. ■ Generalize and explain strategies for graphing a linear relation in slope–intercept, general, or slope–point form. ■ Graph, with or without technology, a linear relation given in slope–intercept, general, or slope–point form, and explain the strategy used to create the graph. ■ Identify equivalent linear relations from a set of linear relations. ■ Match a set of linear relations to their graphs.
10I.R.7.	Determine the equation of a linear relation, given ■ a graph ■ a point and the slope ■ two points ■ a point and the equation of a parallel or perpendicular line ■ a scatterplot [C, CN, PS, R, T, V]	■ Determine the slope and y-intercept of a linear relation from its graph, and write the equation in the form $y = mx + b$. ■ Write the equation of a linear relation, given its slope and the coordinates of a point on the line, and explain the process. ■ Write the equation of a linear relation, given the coordinates of two points on the line, and explain the process. ■ Write the equation of a linear relation, given the coordinates of a point on the line and the equation of a parallel or perpendicular line, and explain the process. ■ Graph linear data generated from a context, and write the equation of the resulting line. ■ Determine the equation of the line of best fit from a scatterplot using technology, and discuss the correlation. ■ Solve a contextual problem, using the equation of a linear relation.

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		[V]	Visualization

Strand: Relations and Functions *(continued)*		**General Learning Outcome:** Develop algebraic and graphical reasoning through the study of relations.
	Specific Learning Outcomes *It is expected that students will:*	**Achievement Indicators** *The following set of indicators **may** be used to determine whether students have met the corresponding specific learning outcome.*
10I.R.8.	Represent a linear function, using function notation. [CN, ME, V]	■ Express the equation of a linear function in two variables, using function notation. ■ Express an equation given in function notation as a linear function in two variables. ■ Determine the related range value, given a domain value for a linear function. ■ Determine the related domain value, given a range value for a linear function. ■ Sketch the graph of a linear function expressed in function notation.
10I.R.9.	Solve problems that involve systems of linear equations in two variables, graphically and algebraically. [CN, PS, R, T, V]	■ Model a situation, using a system of linear equations. ■ Relate a system of linear equations to the context of a problem. ■ Determine and verify the solution of a system of linear equations graphically, with or without technology. ■ Explain the meaning of the point of intersection of a system of linear equations. ■ Determine and verify the solution of a system of linear equations algebraically. ■ Explain, using examples, why a system of equations may have no solution, one solution, or an infinite number of solutions. ■ Describe a strategy to solve a system of linear equations. ■ Solve a contextual problem that involves a system of linear equations, with or without technology.
10I.R.10.	Solve problems that involve the distance between two points and the midpoint of a line segment. [C, CN, PS, T, V]	■ Determine the distance between two points on a Cartesian plane, using a variety of strategies. ■ Determine the midpoint of a line segment, given the endpoints of the segment, using a variety of strategies. ■ Determine an endpoint of a line segment, given the other endpoint and the midpoint, using a variety of strategies. ■ Solve a contextual problem involving distance between two points or midpoint of a line segment.