**Area of Learning: MATHEMATICS — Pre-calculus Grade 11**

**BIG IDEAS**

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| Algebra allows us to **generalize** relationships through abstract thinking. |  | The meanings of, and **connections** between, operations extend to powers, radicals, and polynomials. |  | Quadratic **relationships** are prevalent in the world around us. |  | Trigonometry involves using **proportional reasoning** to solve **indirect measurement** problems. |

**Learning Standards**

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| **Curricular Competencies** | **Content** |
| *Students are expected to do the following:*Reasoning and modelling* Develop **thinking strategies** to solve puzzles and play games
* Explore, **analyze**, and apply mathematical ideas using **reason**, **technology**, and **other tools**
* **Estimate reasonably** and demonstrate **fluent, flexible, and strategic thinking** about number
* **Model** with mathematics in **situational contexts**
* **Think** **creatively** and with **curiosity and wonder** when exploring problems

Understanding and solving* Develop, demonstrate, and apply conceptual understanding of mathematical ideas through play, story, **inquiry**, and problem solving
* **Visualize** to explore and illustrate mathematical concepts and relationships
* Apply **flexible and strategic approaches** to **solve problems**
* Solve problems with **persistence and a positive disposition**
* Engage in problem-solving experiences **connected** with place, story, cultural practices, and perspectives relevant to local First Peoples communities, the local community, and other cultures
 | *Students are expected to know the following:** **real number** system
* **powers** with rational exponents
* **radical** operations and equations
* polynomial **factoring**
* **rational** expressions and equations
* **quadratic** functions and equations
* linear and quadratic **inequalities**
* **trigonometry:** non-right triangles and angles in standard position
* **financial literacy:** compound interest,investments, loans
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**Area of Learning: MATHEMATICS — Pre-calculus Grade 11**

**Learning Standards (continued)**

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| **Curricular Competencies** | **Content** |
| Communicating and representing* **Explain and justify** mathematical ideas and **decisions** in **many ways**
* **Represent** mathematical ideas in concrete, pictorial, and symbolic forms
* Use mathematical vocabulary and language to contribute to **discussions** in the classroom
* Take risks when offering ideas in classroom **discourse**

Connecting and reflecting* **Reflect** on mathematical thinking
* **Connect mathematical concepts** with each other, with other areas, and with personal interests
* Use **mistakes** as **opportunities to advance learning**
* **Incorporate** First Peoples worldviews, perspectives, **knowledge**, and **practices** to makeconnections with mathematical concepts
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|  **MATHEMATICS – Pre-calculus Big Ideas – Elaborations Grade 11** |
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| * **generalize:**

*Sample questions to support inquiry with students:** + After solving a problem, can we extend it? Can we generalize it?
	+ How can we take a contextualized problem and turn it into a mathematical problem that can be solved?
	+ How do we tell if a mathematical solution is reasonable?
	+ Where can errors occur when solving a contextualized problem?
	+ What are the similarities and differences between quadratic functions and linear functions? How are they connected?
	+ What do we notice about the rate of change in a quadratic function?
	+ How do the strategies for solving linear equations extend to solving quadratic, radical, or rational equations?
	+ What is the connection between domain and extraneous roots?
* **connections:**

*Sample questions to support inquiry with students:** + How are the different operations (+, -, x, ÷, exponents, roots) connected?
	+ What are the similarities and differences between multiplication of numbers, powers, radicals, polynomials, and rational expressions?
	+ How can we verify that we have factored a trinomial correctly?
	+ How can visualization support algebraic thinking?
	+ How can patterns in numbers lead to algebraic generalizations?
	+ When would we choose to represent a number with a radical rather than a rational exponent?
	+ How do strategies for factoring $x^{2}+bx+c$ extend to $ax^{2}+bx+c, a\ne 1$
	+ How do operations on rational numbers extend to operations with rational expressions?
* **relationships:**

*Sample questions to support inquiry with students:** + What are some examples of quadratic relationships in the world around us, and what are the similarities and differences between these?
	+ Why are quadratic relationships so prevalent in the world around us?
	+ How does the predictable pattern of linear functions extend to quadratic functions?
	+ Why is the shape of a quadratic function called a parabola?
	+ How can we decide which form of a quadratic function to use for a given problem?
	+ What effect does each term of a quadratic function have on its graph?
* **proportional reasoning:**
	+ comparisons of relative size or scale instead of numerical difference
* **indirect measurement:**
	+ using measurable values to calculate immeasurable values (e.g., calculating the width of a river using the distance between two points on one shore and an angle to a point on the other shore)

*Sample questions to support inquiry with students:** + How is the cosine law related to the Pythagorean theorem?
	+ How can we use right triangles to find a rule for solving non-right triangles?
	+ How do we decide when to use the sine law or cosine law?
	+ What would it mean for an angle to have a negative measure? Identify a context for making sense of a negative angle.
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|  **MATHEMATICS – Pre-calculus Curricular Competencies – Elaborations Grade 11** |
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| * **thinking strategies:**
	+ using reason to determine winning strategies
	+ generalizing and extending
* **analyze:**
	+ examine the structure of and connections between mathematical ideas (e.g., trinomial factoring, roots of quadratic equations)
* **reason:**
	+ inductive and deductive reasoning
	+ predictions, generalizations, conclusions drawn from experiences (e.g., with puzzles, games, and coding)
* **technology:**
	+ graphing technology, dynamic geometry, calculators, virtual manipulatives, concept-based app
	+ can be used for a wide variety of purposes, including:
		- exploring and demonstrating mathematical relationships
		- organizing and displaying data
		- generating and testing inductive conjectures
		- mathematical modelling
* **other tools:**
	+ manipulatives such as algebra tiles and other concrete materials
* **Estimate reasonably:**
	+ be able to defend the reasonableness of an estimated value or a solution to a problem or equation (e.g., the zeros of a graphed polynomial function)
* **fluent, flexible and strategic thinking:**
	+ includes:
		- using known facts and benchmarks, partitioning, applying whole number strategies to rational numbers and algebraic expressions
		- choosing from different ways to think of a number or operation (e.g., Which will be the most strategic or efficient?)
* **Model:**
	+ use mathematical concepts and tools to solve problems and make decisions (e.g., in real-life and/or abstract scenarios)
	+ take a complex, essentially non-mathematical scenario and figure out what mathematical concepts and tools are needed to make sense of it
* **situational contexts**:
	+ including real-life scenarios and open-ended challenges that connect mathematics with everyday life
* **Think creatively:**
	+ by being open to trying different strategies
	+ refers to creative and innovative mathematical thinking rather than to representing math in a creative way, such as through art or music
* **curiosity and wonder:**
	+ asking questions to further understanding or to open other avenues of investigation
* **inquiry:**
	+ includes structured, guided, and open inquiry
	+ noticing and wondering
	+ determining what is needed to make sense of and solve problems
* **Visualize:**
	+ create and use mental images to support understanding
	+ Visualization can be supported using dynamic materials (e.g., graphical relationships and simulations), concrete materials, drawings, and diagrams.
* **flexible and strategic approaches:**
	+ deciding which mathematical tools to use to solve a problem
	+ choosing an effective strategy to solve problems (e.g., guess and check, model, solve a simpler problem, use a chart, use diagrams, role-play)
* **solve problems:**
	+ interpret a situation to identify a problem
	+ apply mathematics to solve the problem
	+ analyze and evaluate the solution in terms of the initial context
	+ repeat this cycle until a solution makes sense
* **persistence and a positive disposition:**
	+ not giving up when facing a challenge
	+ problem solving with vigour and determination
* **connected:**
	+ through daily activities, local and traditional practices, popular media and news events, cross-curricular integration
	+ by posing and solving problems or asking questions about place, stories, and cultural practices
* **Explain and justify:**
	+ use mathematical arguments to convince
	+ includes anticipating consequences
* **decisions:**
	+ Have students explore which of two scenarios they would choose and then defend their choice.
* **many ways:**
	+ including oral, written, visual, use of technology
	+ communicating effectively according to what is being communicated and to whom
* **Represent:**
	+ using models, tables, graphs, words, numbers, symbols
	+ connecting meanings among various representations
* **discussions:**
	+ partner talks, small-group discussions, teacher-student conferences
* **discourse:**
	+ is valuable for deepening understanding of concepts
	+ can help clarify students’ thinking, even if they are not sure about an idea or have misconceptions
* **Reflect:**
	+ share the mathematical thinking of self and others, including evaluating strategies and solutions, extending, posing new problems and questions
* **Connect mathematical concepts:**
	+ to develop a sense of how mathematics helps us understand ourselves and the world around us (e.g., daily activities, local and traditional practices, popular media and news events, social justice, cross-curricular integration)
* **mistakes:**
	+ range from calculation errors to misconceptions
* **opportunities to advance learning:**
	+ by:
		- analyzing errors to discover misunderstandings
		- making adjustments in further attempts
		- identifying not only mistakes but also parts of a solution that are correct
* **Incorporate:**
	+ by:
		- collaborating with Elders and knowledge keepers among local First Peoples
		- exploring the [First Peoples Principles of Learning](http://www.fnesc.ca/wp/wp-content/uploads/2015/09/PUB-LFP-POSTER-Principles-of-Learning-First-Peoples-poster-11x17.pdf) (e.g., Learning is holistic, reflexive, reflective, experiential, and relational [focused on connectedness, on reciprocal relationships, and a sense of place]; Learning involves patience and time)
		- making explicit connections with learning mathematics
		- exploring cultural practices and knowledge of local First Peoples and identifying mathematical connections
* **knowledge:**
	+ local knowledge and cultural practices that are appropriate to share and that are non-appropriated
* **practices:**
	+ [Bishop’s cultural practices](http://www.csus.edu/indiv/o/oreyd/ACP.htm_files/abishop.htm): counting, measuring, locating, designing, playing, explaining
	+ [Aboriginal Education Resources](http://www.aboriginaleducation.ca/)
	+ [*Teaching Mathematics in a First Nations Context*,](http://www.fnesc.ca/resources/math-first-peoples/) FNESC
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|  **MATHEMATICS – Pre-calculus Content – Elaborations Grade 11** |
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| * **real number:**
	+ Classification
* **powers:**
	+ positive and negative rational exponents
	+ exponent laws
	+ evaluation using order of operations
	+ numerical and variable bases
* **radical:**
	+ simplifying radicals
	+ ordering a set of irrational numbers
	+ performing operations with radicals
	+ solving simple (one radical only) equations algebraically and graphically
	+ identifying domain restrictions and extraneous roots of radical equations
* **factoring:**
	+ greatest common factor of a polynomial
	+ trinomials of the form $ax^{2}+bx+c$
	+ difference of squares of the form$ a^{2}x^{2}-b^{2}y^{2}$
	+ may extend to $a\left(f\left(x\right)\right)^{2}+b\left(f\left(x\right)\right)+c$, $a^{2}\left(f\left(x\right)\right)^{2}-b^{2}\left(f\left(x\right)\right)^{2}$
* **rational:**
	+ simplifying and applying operations to rational expressions
	+ identifying non-permissible values
	+ solving equations and identifying any extraneous roots
* **quadratic:**
	+ identifying characteristics of graphs (including domain and range, intercepts, vertex, symmetry), multiple forms, function notation, extrema
	+ exploring transformations
	+ solving equations (e.g., factoring, quadratic formula, completing the square, graphing, square root method)
	+ connecting equation-solving strategies
	+ connecting equations with functions
	+ solving problems in context
* **inequalities:**
	+ single variable (e.g., $3x-7\leq -4, x^{2}-5x+6>0$)
	+ domain and range restrictions from problems in situational contexts
	+ sign analysis: identifying intervals where a function is positive, negative, or zero
	+ symbolic notation for inequality statements, including interval notation
* **trigonometry:**
	+ use of sine and cosine laws to solve non-right triangles, including ambiguous cases
	+ contextual and non-contextual problems
	+ angles in standard position:
		- degrees
		- special angles, as connected with the 30-60-90 and 45-45-90 triangles
	+ unit circle
	+ reference and coterminal angles
	+ terminal arm
	+ trigonometric ratios
	+ simple trigonometric equations
* **financial literacy:**
	+ compound interest
	+ introduction to investments/loans with regular payments, using technology
	+ buy/lease
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