**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 |

**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 |  |

| **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 extend to   + 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. |

| **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 |

| **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   + difference of squares of the form   + may extend to , * **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., )   + 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 |