BIG IDEAS

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

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

Learning Standards (continued)

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 make connections with mathematical concepts	

- **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 $ax^2 + bx + c, a \neq 1$
  - 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

Big Ideas – Elaborations

- **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
Grade 11

Curricular Competencies – Elaborations

- **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 (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: counting, measuring, locating, designing, playing, explaining
  - Aboriginal Education Resources
  - *Teaching Mathematics in a First Nations Context*, FNESC

Content – Elaborations

- **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 $a^2x^2 - b^2y^2$
  - may extend to $a\big(f(x)\big)^2 + b\big(f(x)\big) + c$, $a^2\big(f(x)\big)^2 - b^2\big(f(x)\big)^2$
- **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

Content – Elaborations

- **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

