Overall Expectations for Unit 1: Quadratic Functions

1. Expand and simplify quadratic expressions, solve quadratic equations, and relate the roots of a quadratic equation to the corresponding graph
2. Demonstrate an understanding of functions, and make connections between the numeric, graphical and algebraic representations of quadratic functions;
3. Solve problems involving quadratic functions, including problems arising from real-world applications

Specific Expectations for Unit 1: Quadratic Functions

1.1 pose problems involving quadratic relations arising from real-world applications and represented by tables of values and graphs, and solve these and other such problems

1.2 represent situations using quadratic expressions in one variable, and expand and simplify quadratic expressions in one variable

1.3 factor quadratic expressions in one variable, including those for which $a \neq 1$ (e.g., $3x^2 + 13x - 10$), differences of squares (e.g., $4x^2 - 25$), and perfect square trinomials (e.g., $9x^2 + 24x + 16$), by selecting and applying an appropriate strategy

1.4 solve quadratic equations by selecting and applying a factoring strategy

1.5 determine, through investigation, and describe the connection between the factors used in solving a quadratic equation and the x-intercepts of the graph of the corresponding quadratic relation

1.6 explore the algebraic development of the quadratic, and apply the formula to solve quadratic equations, using technology

1.7 relate the real roots of a quadratic equation to the x-intercepts of the corresponding graph, and connect the number of real roots to the value of the discriminant

1.8 determine the real roots of a variety of quadratic equations (e.g., $100x^2 = 115x + 35$), and describe the advantages and disadvantages of each strategy

2.1 explain the meaning of the term function, and distinguish a function from a relation that is not a function, through investigation of linear and quadratic relations using a variety of representations (i.e., tables of values, mapping diagrams, graphs, function machines, equations) and strategies (e.g., using the vertical line test)

2.2 substitute into and evaluate linear and quadratic functions represented using function notation [e.g., evaluate $f(\frac{1}{2})$, given $f(x) = 2x^2 + 3x - 1$], including functions arising from real-world applications

2.3 explain the meanings of the terms domain and range, through investigation using numeric, graphical, and algebraic representations of linear and quadratic functions, and describe the domain and range of a function appropriately

2.4 explain any restrictions on the domain and the range of a quadratic function in contexts arising from real-world applications

2.5 determine, through investigation using technology, the roles of a, h, and k in quadratic functions of the form $f(x) = a(x – h)^2 + k$, and describe these roles in terms of transformations on the graph of $f(x) = x^2$

2.6 sketch graphs of $g(x) = a(x – h)^2 + k$ by applying one or more transformations to the graph of $f(x) = x^2$

2.7 express the equation of a quadratic function in the standard form $f(x) = ax^2 + bx + c$, given the vertex form $f(x) = a(x – h)^2 + k$, and verify, using graphing technology, that these forms are equivalent representations

2.8 express the equation of a quadratic function in the vertex form $f(x) = a(x – h)^2 + k$, given the standard form $f(x) = ax^2 + bx + c$, by completing the square (e.g., using algebra tiles or diagrams; algebraically), including cases where $\frac{b}{a}$ is a simple rational number (e.g., $\frac{1}{2}$, 0.75), and verify, using graphing technology, that these forms are equivalent representations

2.9 sketch graphs of quadratic functions in the factored form $f(x) = a(x – r)(x – s)$ by using the x-intercepts to determine the vertex

2.10 describe the information (e.g., maximum, intercepts) that can be obtained by inspecting the standard form $f(x) = ax^2 + bx + c$, the vertex form $f(x) = a(x – h)^2 + k$, and the factored form $f(x) = a(x – r)(x – s)$ of a quadratic function

2.11 sketch the graph of a quadratic function whose equation is given in the standard form $f(x) = ax^2 + bx + c$ by using a suitable strategy (e.g., completing the square and finding the vertex; factoring, if possible, to locate the x-intercepts), and identify the key features of the graph

3.1 collect data that can be modelled as a quadratic function, through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials; measurement tools such as measuring tapes, electronic probes, motion sensors), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data

3.2 determine, through investigation using a variety of strategies (e.g., applying properties of quadratic functions such as the x-intercepts and the vertex; using transformations), the equation of the quadratic function that best models a suitable data set graphed on a scatter plot, and compare this equation to the equation of a curve of best fit generated with technology

3.3 solve problems arising from real-world applications, given the algebraic representation of a quadratic function

Stage 1: Desired Results

Big ideas:

Students will understand:

- the connection between the algebraic and graphical representation of a quadratic relation
- that real life situations can be modelled by quadratic relations

Success Criteria:

Students will know how to:

- Factor
- Complete the square
- Use the quadratic formula
- Manipulate quadratic expressions

Students will be able to:

- Identify quadratic relationships and their characteristics
- Translate between different representations of quadratic expressions
- Identify real-life applications for quadratic relations
- Make connections between the algebraic representation and the real-life meaning of quadratic relations
- Describe how changes to the algebraic equation will change the graphical representation of quadratic relations

Major Questions:

What is a quadratic relation?

What characteristics do quadratic relations have?

How can I solve a quadratic equations?

How can I graphically represent a quadratic relation? What are its characteristics?

How can I transition from a graphical representation to an algebraic representation?

How can one transition from the algebraic representation to the graphical representation?

What real-life scenarios can be modeled effectively by quadratic relations?