

Unit 4 - Applying Function Concepts Using Quadratic Functions: BIG PICTURE:

Once a foundational concept is understood, we can develop new knowledge and new ideas as we extend the foundational concept by simply asking "what if ..." or "what about" or "how would things change if" **Any** topic in math can be CONNECTED to "foundational ideas" & EXTENDED to "new ideas" as new ideas/skills/process get introduced or get applied, so in this unit we will demonstrate this connection & extension of our knowledge of functions in general, but also specifically exponential & logarithmic Functions.

(1) FORMS, FEATURES AND QUADRATIC ALGEBRA: Fundamental algebraic skills related to working with quadratic expressions and equations will be reviewed and extended (expanding with binomials, factoring trinomials, solve); multiple forms of quadratic equations will be explored (all variations of $y = ab^x$ though); conversion between these forms; contextual applications of quadratic models

(2) FUNCTION CONCEPTS: We will demonstrate this EXTENSION & CONNECTION in our study of Functions → using quadratic functions to reinforce function concepts like (i) inverse of functions i.e. use the idea that "solving" for a variable is simply the idea of "undoing" operations and thereby reinforce the idea of undoing as being "inversing" the operations and now asking the extending question → how do I "undo" (or inverse) a trinomial (where we have BOTH linear and quadratic functions), (ii) composition of functions, (iii) transformation of functions, (iv) graphs & features of quadratic functions

(3) ADVANCED QUADRATIC related concepts, as we EXTEND our ideas from IM2 to new concepts including (i) the quadratic formula (ii) vertex form & its connection to transformations; (iii) quadratic composites (using linear or trig equations in quadratic form), (iv) catenary functions like $f(x) = e^x + e^{-x}$ that "look" parabolic (v) complex numbers & finding the square roots of negative numbers

Quadratic Basics:

1. Be able to evaluate ($f(2) = ?$) with all three forms of QF
2. Be able to solve ($f(x) = 2$) with all three forms of QF
3. Be able to analyze all three forms of QF for key features (vertex, roots, y-intercepts, points), from both its equation or its graph, with and without the use of graphing display calculators
4. Be able to graph/sketch QF from equations presented in any of the three forms
5. Be able to apply concepts from the previous unit (functions) including inverses and transformations to quadratic functions
6. Be able to graph and analyze quadratic functions effectively using the TI-84

Quadratic Algebra:

7. Be able to multiply (expand) binomial products and factor quadratic expressions and understand that the two processes are reverse processes of each other
8. Be able to convert equations from one form to another (standard, factored, vertex)
9. Be able to solve QE in the form of $f(x) = 0$ using (i) factorization (when $a = 1$ and when $a > 1$) and understand the graphic significance of solutions (ii) the square root method, when $a = 1$ and $a > 1$; (iii) The quadratic formula.
10. Be able to solve QE in the form of $f(x) = 0$ using the Quadratic Formula.
11. Use the completing the square method to (i) rearrange equations into vertex form and (ii) solve quadratic equations
12. Be able to solve QE using ANY method when presented with equations in the form of systems (i.e. solving $f(x) = g(x)$ where either or both f & g are quadratic functions)
13. Be able to use the discriminant to predict the number of solutions to the quadratic equations
14. Be able to understand the connection between roots (zeroes) & factors

Application of Quadratic Models:

15. Be able to apply the features of QF in contextual problems → model situations wherein the data context calls for a quadratic model in the first place (projectiles, revenue/expenses, populations)
16. be able to apply knowledge of quadratic functions (features & algebra) to contextual problems when provided with (i) the equation, (ii) the graph, (iii) a data set
17. be able to create and solve quadratic equations from word problems
18. be able to write equations for quadratic data sets with and without a graphing display calculator
19. be able to calculate second differences as a simple data analysis method which can justify the selection of a quadratic function to model the data
20. Be able to work through contextual data using (a) regressions given a set of data & (b) determining and interpreting the r^2 value to test the accuracy of your model

Extension of Concepts Related to Quadratic Functions:

21. Be able to understand the need for an additional number set (called the complex numbers)
22. Be able to understand what complex numbers are
23. Be able to solve equations using complex numbers
24. Be able to perform simple algebra with complex numbers
25. Be able to compose quadratic functions with (i) linear, (ii) exponential and (iii) absolute value and then graph and algebraically analyze the composite function
26. Solve quadratic inequalities

