# Unit 3 Solving Quadratics

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **6-7 weeks**
Status: **Published**

## Brief Summary of Unit

In this unit, students will learn more heavily into the algebraic side of quadratics by solving equations (in many ways) which will introduce complex numbers. The next section will focus on using basic algebraic operations on complex numbers. With this knowledge, students will continue to solve quadratic equation by focusing on completing the square and using the quadratic formula. Finally, students will solve nonlinear systems of equations and quadratic inequalities.

**Revision Date:** July 2024

## Standards

| | |
|---|---|
| 9.2.12.CAP.3 | Investigate how continuing education contributes to one's career and personal growth. |
| L.KL.9–10.2.A | Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level. |
| 9.2.12.CAP.6 | Identify transferable skills in career choices and design alternative career plans based on those skills. |
| N.CN.A.1 | Know there is a complex number $i$ such that $i^2 = -1$, and every complex number has the form $a + bi$ with $a$ and $b$ real. |
| N.CN.A.2 | Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. |
| A.CED.A.1 | Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. |
| A.CED.A.3 | Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. |
| N.CN.C.7 | Solve quadratic equations with real coefficients that have complex solutions. |
| A.REI.B.4.b | Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers $a$ and $b$. |
| F.IF.C.8 | Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. |
| A.REI.D.11 | Explain why the $x$-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, |

| | |
|---|---|
| | rational, absolute value, exponential, and logarithmic functions. |
| SL.PE.11–12.1.A | Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas. |

## Essential Questions

- How can you use completing the square to solve a quadratic?
- How can you use the quadratic formula to solve a quadratic?
- How many solution points are there in various nonlinear systems of equations?
- What are three ways to solve a quadratic equation?
- What is a complex number and how is it simplified?
- What is a discriminant and how is this useful for solving a quadratic?
- What is the solution set for a quadratic inequality with one variable?
- What is the solution set for a quadratic inequality with two variables?

## Enduring Understandings

- Graph quadratic inequalities in two variables and solve quadratic inequalities in one variable.
- Solve and analyze quadratic equations using the quadratic formula and discriminants.
- Solve nonlinear systems graphically and algebraically.
- Solve quadratic equations and rewrite quadratic functions by completing the square.
- Solve quadratic equations graphically and algebraically.
- Understand the imaginary unit i and perform operations with complex numbers.

## Students Will Know

- Nonlinear systems and quadratic inequalities.
- Operations with complex numbers.
- Quadratic equations by completing the square.
- The quadratic formula.

## Students Will Be Skilled At

- Adding, subtracting, and multiplying complex numbers.
- Defining the imaginary unit i.
- Describing and graphing quadratic inequalities.
- Finding and interpreting the discriminant of an equation.
- Finding complex solutions of quadratic equations and complex zeros of quadratic functions.
- Solving a nonlinear system using graphing substitution, and elimination.

- Solving quadratic equations by completing the square.
- Solving quadratic equations by graphing and algebraically.
- Solving quadratic equations by quadratic formula.
- Solving quadratic inequalities algebraically.
- Using quadratic equations to solve real life problems.
- Writing quadratic equations to model data sets.

## Evidence/Performance Tasks

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions
- Class discussion of daily topic
- Classwork and homework that assess the essential questions
- Provide alternative means of assessments for certain students
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations

## Learning Plan

The following list is meant to create a day-to-day plan. Teachers are encouraged to slow down or condense days as appropriate to the student population in the class. Assessment(s) should be given when appropriate.

- Students will first use their graphing skills from previous units to solve a quadratic equation. Then, they will recall how to solve a quadratic binomial (ax^2+c) equation by using square roots. Finally students will recall their factoring skills to solve a quadratic trinomial (ax^2+bx+c) equation.
- Students will likely need additional time to practice the differences between these methods, and the benefits of each.
- Presented with a real-life application, students should solve a quadratic equation using any/all of the practiced methods.
- Introduce the concept of an imaginary number, how to simplify it, and its place in the number system.

At the same time, begin using three algebra operations (add, subtract, multiply) on complex numbers.

- Students will likely need additional time to practice how to use these operations on imaginary numbers, especially when simplifying i with an exponent.
- Reintroduce solving a quadratic binomial equation using square roots with complex number answers to incorporate how the quadratic will look on a graph.
- Have students recall what they can from Algebra 1 about completing the square, and fill in missing gaps of knowledge.
- Students will likely need additional time to practice, especially if a>1 in the equation.
- Have students recall what they can from Algebra 1 about quadratic formula, and fill in missing gaps of knowledge. Be sure that some examples include complex numbers as answers, and practice simplifying answers.
- Introduce the discriminant and how to analyze it for solution types and quantity.
- Remind students that a system is multiple equations that should intersect at one point on a graph. Extend this to nonlinear equations, and describe how the quantity of solutions can change based on what the nonlinear equations are. Practice this by graphing one quadratic and one linear, as well as two quadratics. (For advanced students, include circles here with a quick refresher on how to graph a circle from Geometry.)
- Students should remember that graphing is not the only way to solve a system, so move into using elimination and substitution as alternate methods to solving nonlinear systems. Again focus on one quadratic and one linear, as well as two quadratics. You can also now introduce using a circle in these more algebraic methods.
- Students will likely need additional time to practice these three methods of solving nonlinear systems.
- Start by having students recall how to graph two variable linear inequalities on a graph. Extend this knowledge to a two variable quadratic inequality, as well as a system of two variable quadratic inequalities.
- Start by having students recall how to graph a one variable linear inequality on a number line. Extend this knowledge to a one variable quadratic inequality. Remind students that they must solve the quadratic first, and they should be encouraged to use any method previously discussed to do so. Then, introduce the test values that must be used to determine which way the inequality is facing on the number line.

## Materials

Core instructional materials:Core Book List including Big Ideas Math Algebra 2 2022

Supplemental materials: Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Teacher created activiites
- Teacher created notes

## Suggested Strategies for Modifications

Possible accommodations/modification for Algebra 2