3rd Period

2.A.REI.B.3 Solve quadratic equations and inequalities in one variable. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, knowing and applying 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 ± bi for real numbers a and b.

A.2.N.CN.B.3 (formerly N-CN.B. 7) Solve quadratic equations with real coefficients that have complex solutions.

# 4-5 Quadratic Equations

**Objective:** Students will solve quadratic equations by factoring, graphing and calculator (x intercepts or intersection of left side and right side of the equation as two functions) and use those skills to solve real life problems.

**Warm up** if (x+2)(2x-1) = 0, which values of x would make this equation true? Explain. $x=-2$ $x=\frac{1}{2}$

$2x-1=0$, $2x=1$, $x=\frac{1}{2}$

**Key Concepts** **zero product property: if ab=0, then a=0 or b=0**

zero, ROOT, x-intercepts (y=0) -all mean a **solution** of a quadratic equation.

1.90, 2.45, 3-30, 6-15

1. **Examples** Solve the quadratic equations by factoring. $(a \pm b)^2 = a^2 \pm 2ab + b^2$

a) $4x^2 - 12x + 9 = 0$ $a=2x$, $b=3$, $2ab$, $(2x-3)^2=0$, $x=3/2$

b) $x^2 - 7x = -12$ $x^2-7x+12=0$, $(x-3)(x-4)=0$, $x=3$ $x=4$

c) $5x^2 - 9x = 18$ $5x^2-9x-18=0$, $x^2-9x-90=0$, $(x+6)(x-15)$, $(5x+6)(x-3)=0$, $x=-6/5$ $x=3$

d) $a^2 - 4a = 0$ $a(a-4)=0$, $a=0$ $a=4$

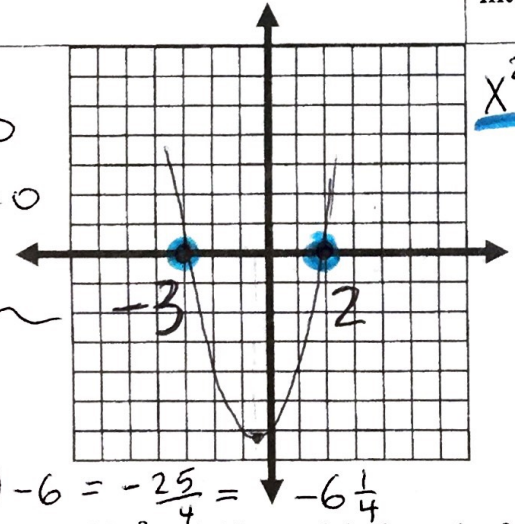
2. Solve the quadratic by graphing $x^2 + x = 6$

**Method 1**- set equation equal to zero then graph the function (the x intercepts are your solutions)

$x^2+x=6$, $x^2+x-6=0$, $(x+3)(x-2)=0$, $x=-3$, $x=2$

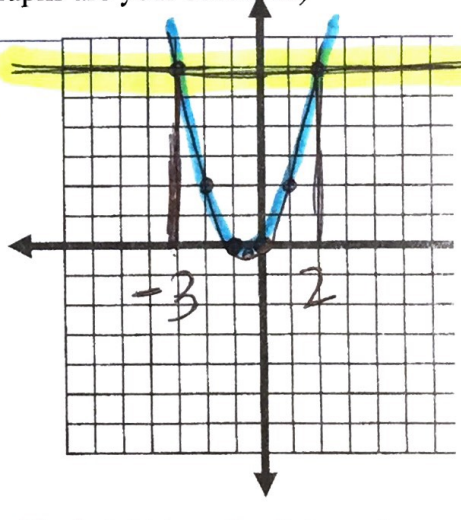
vertex $h=\frac{-b}{2a}=\frac{-1}{2}$

$k=(-\frac{1}{2})^2+(-\frac{1}{2})-6=-\frac{25}{4}=-6\frac{1}{4}$




**Method 2** – graph left side of the equation as the first function, right side as the second (the points of intersection of those graphs are your solutions)

$x^2+x=6$




3. The function $y = -0.03x^2 + 1.60x$ models the path of a kicked soccer ball. The height is $y$, the distance is $x$ and the units are meters.
   a. How high does the soccer ball go?
   b) How far does the soccer ball travel?

**Workbook page 101 MINI WHITE BOARD ACTIVITY** **1)** **2)** **3)**

**Extra credit/Early Finishers** **THINK ABOUT A PLAN in workbook page 98**

**Exit ticket** **Solve $-x^2 + 4 = -3x$** use the slips in your baskets and submit on your way out.

*Please do not forget to clean up after yourselves, and place all calculators and materials in the basket*

**A2.A.REI.B.3** Solve quadratic equations and inequalities in one variable. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, knowing and applying 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 ± bi for real numbers a and b.

# 4-6 Completing the Square

**Objective** Students will solve equations, and solve problems involving functions by completing the square.

Warm up What number should I place at the end of the polynomial in order for the trinomial to be perfect square? Explain.

a) $x^2 - 10x + 25$ $a^2 - 2ab + b^2$ $b=5$ $a=x$ $2ab = 10x$

b) $x^2 + 6x + \_\_\_$ $2ab$ $2 \cdot b = 6x$

c) $4x^2 + 12x + \_\_\_$ $2ab$ $2 \cdot b = 12x$

**Key Concepts**

perfect square trinomial - the product you obtain when you square a binomial $(a +/- b)^2 = a^2 +/- 2ab + b^2$

**Examples**

1. Solve by finding the square roots

a. $4x^2 = 36$

$\frac{4x^2}{4} = \frac{36}{4}$

$x^2 = 9$

$x = \pm 3$

b. $7x^2 - 10 = 25$

$+10 \quad +10$

$\frac{7x^2}{7} = \frac{35}{7}$

$x^2 = 5$

$x = \pm\sqrt{5}$

c. $2x^2 + 9 = 13$

$-9 \quad -9$

$\frac{2x^2}{2} = \frac{4}{2}$

$x^2 = 2$

$x = \pm\sqrt{2}$

2. Solve by completing the square.

a. $x^2 + 6x + 9 = 49$

$(x+3)^2 = 49$

$x+3 = 7$ or $x+3 = -7$

$x = 4 \qquad x = -10$

b. $x^2 - 12x + 7 = 0$

$+29 \quad +29$

$a^2 - 2ab$ ? ← needs to be 36

$a=x$ $2 \cdot x \cdot b = 12x$

$b = 6$

$x^2 - 12x + 36 = 29$

$(x-6)^2 = 29$

$x - 6 = \sqrt{29}$ or $x - 6 = -\sqrt{29}$

$x = 6 + \sqrt{29}$ or $x = 6 - \sqrt{29}$

c. $3x^2 - 12x + 6 = 0$

$3(x^2 - 4x + 2) = 0$ ← $b^2$ needs to be 4

$a^2 - 2ab + b^2$ $+2 \quad +6$

$3(x-2)^2 = 6/3$

$(x-2)^2 = 2$

$x - 2 = \sqrt{2}$ or $x - 2 = -\sqrt{2}$

$x = 2 + \sqrt{2}$

$x = 2 - \sqrt{2}$

3. Write the equation in vertex form by completing the square $y = x^2 + 6x - 4$

$y = x^2 + 6x - 4$ ← needs to be 9

$+13 \quad +13$

$y + 13 = (x+3)^2$

$y = (x+3)^2 - 13$

THINK: What's another way to re-write the equation in vertex form (we learned this method in previous lessons)?

$h = \frac{-b}{2a} = \frac{-6}{2 \cdot 1} = \frac{-6}{2} = -3$

$k = (-3)^2 + 6(-3) - 4 = -13$

$y = a(x-h)^2 + k$

$y = (x+3)^2 - 13$

**Workbook page 105 MINI WHITE BOARD ACTIVITY** 1) 2) 3)

**Extra credit/Early Finishers** **THINK ABOUT A PLAN in workbook page 102**

**Exit ticket** **Solve $x^2 + 10x + 16 = 0$ by completing a square** *use the slips in your baskets and submit on your way out.*

*Please do not forget to clean up after yourselves, and place all calculators and materials in the basket*

A2.A.REI.B.3 Solve quadratic equations and inequalities in one variable. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, knowing and applying 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 ± bi for real numbers a & b.

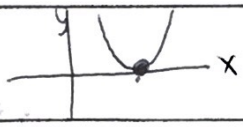
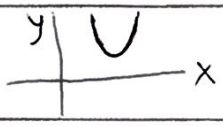
# 4-7 The Quadratic Formula

**Objective** Students will solve quadratic equations using the Quadratic Formula. Students will determine the number of solutions by using the discriminant.

Warm up Solve the zeros of the function by factoring $y = 2x^2+6x+4$

**Key Concepts**

discriminant -the value of the expression $b^2-4ac$ $y = ax^2+bx+c$

| discriminant | Positive | zero | negative |
|---|---|---|---|
| number of real solutions | Two | One | None (there are two imaginary solutions) |
| What does it look like on the graph? |  |  |  |

Quadratic Formula, expressed as $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$ can be used to solve quadratic functions.

**Examples**

**1. Solve the question in the warm up using the Quadratic Formula.**

$y = 2x^2+6x+4 \quad a=2 \quad b=6 \quad c=4$

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ ← discriminant

$x = \frac{-6 \pm \sqrt{6^2-4\cdot2\cdot4}}{2\cdot2} = \frac{-6 \pm \sqrt{4}}{4}$

$x_1 = \frac{-6+2}{4} = -1 \qquad x_2 = \frac{-6-2}{4} = -2$

**2. Solve $3x^2 + 20x = -40$? Use the Quadratic Formula**

$3x^2+20x+40 = 0 \quad a=3 \quad b=20 \quad c=40$

$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{-20 \pm \sqrt{20^2-4\cdot3\cdot40}}{2\cdot3}$

$= \frac{-20 \pm \sqrt{400-480}}{6} = \frac{-20 \pm \sqrt{-80}}{6}$

NO REAL solutions!

**3. What are the x intercepts of $y = 3x^2 + 6x + 3$? Use the Quadratic Formula**

$0 = 3x^2+6x+3 \quad a=3 \quad b=6 \quad c=3$

$x = \frac{-b \pm \sqrt{b^2-4\cdot a\cdot c}}{2a}$

$x = \frac{-6 \pm \sqrt{6^2-4\cdot3\cdot3}}{2\cdot3} = \frac{-6 \pm \sqrt{0}}{6}$

$x = -1$ FACTORS $3(x+1)^2$

**4. What is the number of real solutions of $-2x^2 - 3x + 7 = 0$?**

discriminant $b^2-4ac \quad a=-2 \quad b=-3 \quad c=7$

$(-3)^2-4\cdot(-2)\cdot7$

$9+56 = 65$ positive

TWO REAL solutions

**5.** CHS is selling pumpkin seeds as a fundraiser for the Halloween dance. The total profit $p$ depends on the amount $x$ that CHS charges for each box of seeds. The equation $p = -0.5x^2 + 25x - 150$ models the profit. What is the smallest amount you can charge and make a profit of at least $150? $150 = -0.5x^2+25x-150$, $0 = -0.5x^2+25x-150$

**Workbook page 109 MINI WHITE BOARD ACTIVITY work on a separate sheet questions 1-6**

**Extra credit/Early Finishers** THINK ABOUT A PLAN in workbook page 106

**Exit ticket** Solve $-x^2 + 4 = -3x$ use the slips in your baskets and submit on your way out.

A2.N.CN.A.1 **(formerly 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.
**A2.N.CN.A.2 (formerly N-CN.A.2)** Know and use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

# 4-8 Complex Numbers

**Objective** Students will identify, graph, and perform operations with complex numbers.

**Warm up** What are the roots of the function $y = 2x^2 - 10x + 8$

## Key Concepts

**i** - the imaginary number that is defined as the number whose square is -1.

$i^2 = -1$ $\quad i = \sqrt{-1}$

## Examples

1. Simplify a. $\sqrt{-16}$ $4i$ b. $\sqrt{-11}$ $\sqrt{11}\,i$ c. $\sqrt{-20}$ $2\sqrt{5}\,i$ d. $\sqrt{-125}$ $5\sqrt{5}\,i$

2. Graph each complex number and find its absolute value. a) b)
   a. $-5 + 3i$ $a + bi$ REAL IMAGINARY $|-5+3i| = \sqrt{25+9} = \sqrt{34}$
   $c^2 = a^2 + b^2$ $c = \sqrt{a^2+b^2}$
   b. $2i$ $= 0 + 2i$ $|2i| = 2$

3. Simplify using addition or subtraction.
   a. $(4 - 3i) + (-4 + 3i)$ $0 + 0 = 0$
   b. $(5 - 3i) - (2 + 4i)$ $5 - 3i - 2 - 4i$ $3 - 7i$
   c. $(7 - 2i) + (3 + i)$ $10 - i$

4. Simplify using multiplication.
   a. $(6i)(1 - 5i)$ $6i - 30i^2$ $30 + 6i$
   b. $(7i)(3i)$ $21i^2$ $-21$
   c. $(4 + 3i)(-1 - 2i)$ $2 - 11i$

| | 4 | $+3i$ |
|---|---|---|
| $-1$ | $-4$ | $-3i$ |
| $-2i$ | $-8i$ | $-6i^2$ $+6$ |

   d. $(2 - 4i)^2$ $(a-b)^2 = a^2 - 2ab + b^2$ $2 \cdot 2 \cdot 4i + (4i)^2$ $= 4 - 16i + 16i^2$ $-16 = -12 - 16i$

| | 2 | $-4i$ |
|---|---|---|
| 2 | | |
| $-4i$ | | |

5. Divide.
   a. $\frac{9+12i}{3i}$
   b. $\frac{2+3i}{1-4i}$

6. Solve
   a. $9x^2 + 54 = 0$ $-54$ $\frac{-54}{9}$ $x^2 = -6$ $x = \pm\sqrt{6}\,i$
   b. $x^2 + 5 = 4x$ $x^2 - 4x + 5 = 0$ $a = 1$ $b = -4$ $c = 5$ $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$ $\frac{4 \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 5}}{2}$ $2 \pm i$
   c. $3x^2 - x + 2 = 0$

**Workbook page 113 MINI WHITE BOARD ACTIVITY work on a separate sheet questions 1-8**

**Extra credit/Early Finishers THINK ABOUT A PLAN in workbook page 110**
**Exit ticket Multiply (1-2i)(2+3i)** use the slips in your baskets and submit on your way out.

A2.A.REI.C.5 (formerly A-REI.C.7) Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.

# 4-9 Quadratic Systems

**Objective** Students will solve and graph systems of linear and quadratic equations. Students will find the point(s) of intersection of a linear function and a quadratic function. Students will solve a system consisting of a linear equation and a quadratic equation algebraically.

**Warm up** Solve a system of linear equations $y = -x + 2$ and $y = x - 2$

$-x + 2 = x - 2$

$-2x = -4$

$x = 2$

$y = 2 - 2$

$y = 0$

**Examples**

1. Solve the system by substitution. $\begin{cases} y = x + 6 \\ y = -x^2 + 5x + 6 \end{cases}$

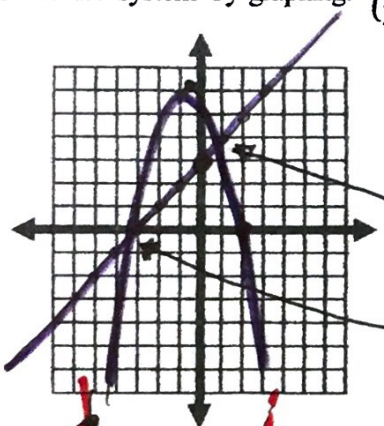
$x + 6 = -x^2 + 5x + 6$

$0 = -x^2 + 4x = -x(x - 4)$

$x = 0 \rightarrow y = 6$

$x = 4 \rightarrow y = 10$

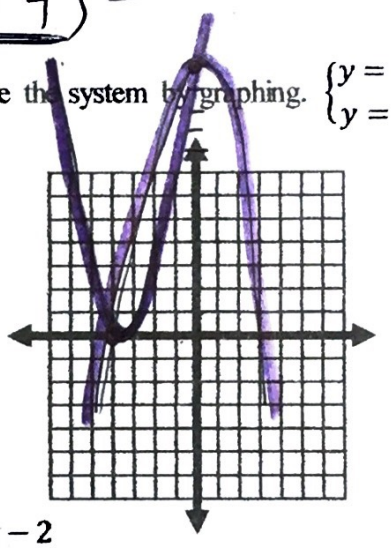
2. Solve the system by graphing. $\begin{cases} y = x + 3 \\ y = -x^2 - x + 6 \end{cases}$ Linear, QUADRATIC



(-0.5, 6.25) vertex

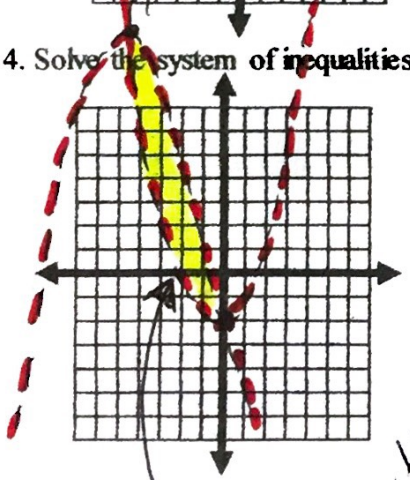
solutions (1, 4) (-3, 0)

3. Solve the system by graphing. $\begin{cases} y = -x^2 - x + 12 \\ y = x^2 + 7x + 12 \end{cases}$



(x, y) (-4, 0) (0, 12)

4. Solve the system of inequalities by graphing. $\begin{cases} y < -x^2 - 9x - 2 \\ y > x^2 - 2 \end{cases}$



below dotted, above dotted

intersection points (-4.5, 18.25) (0, -2)

solution

**Workbook page 117 MINI WHITE BOARD ACTIVITY work on a separate sheet questions 1-4**

**Extra credit/Early Finishers THINK ABOUT A PLAN in workbook page 114**

**Exit ticket question 4 in the workbooks page 117** use the slips in your baskets and submit on your way out.