Name: ______________________________ Date: ________________

THE QUADRATIC FORMULA
COMMON CORE ALGEBRA I

Our final topic in this unit looks at one of the most famous formulas in mathematics, the **Quadratic Formula**. The quadratic formula stems directly from the method of **Completing the Square**. Its proof or derivation is beyond the scope of this course. First, though, we begin with a Completing the Square Problem.

***Exercise* #1:** Solve the equation $x^2+8x+3=0$ by Completing the Square. What type of numbers do your answers represent?

Because of how **algorithmic** this process is, it can be placed in a formula:

THE QUADRATIC FORMULA

For the quadratic equation $ax^2+bx+c=0$, the zeroes can be found by $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$

***Exercise* #2:** For the previous quadratic $x^2+8x+3=0$ identify the following.

(a) The values of a, b, and c in the quadratic formula.

(b) Carefully substitute these values in the quadratic formula and simplify your expression. Compare your result to Exercise #1.

Students often prefer the Quadratic Formula to either **factoring** or **Completing the Square** to find the zeroes of a quadratic because it is so **algorithmic** in nature. Let's compare it to factoring.

***Exercise* #3:** Consider the quadratic equation $2x^2-9x+4=0$.

(a) Find the solutions to this equation by factoring.

(b) Find the solutions to this equation using the Quadratic Formula.

The Quadratic Formula is particularly nice when the solutions are **irrational numbers** and thus cannot be found by factoring. Sometimes, we have to place the answers to these equations in **simplest radical form** and sometimes we just need decimal approximations.

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

***Exercise* #4:** For each of the following quadratic equations, find the solutions using the Quadratic Formula and express your answers in **simplest radical form**.

(a) $x^2 + 6x - 9 = 0$

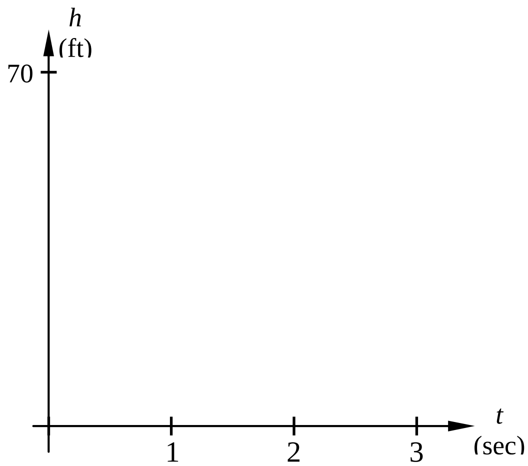
(b) $3x^2 + 4x - 1 = 0$

Many times in applied problems it makes much greater sense to express the answers, even if irrational, as approximated decimals.

***Exercise* #5:** A projectile is fired vertically from the top of a 60 foot tall building. It's height in feet above the ground after *t*-seconds is given by the formula

$$h = -16t^2 + 20t + 60$$

Using your calculator, sketch a graph of the projectile's height, *h*, using the indicated window. At what time, *t*, does the ball hit the ground? Solve by using the quadratic formula to the nearest *tenth* of a second.



Name: ______________________________ Date: ________________

THE QUADRATIC FORMULA
COMMON CORE ALGEBRA I HOMEWORK

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

FLUENCY

1. Solve the equation $x^2-4x-12=0$ two ways:

   (a) By Factoring

   (b) By the Quadratic Formula

2. Solve the equation $x^2+6x+3=0$ two ways. Express your answers both times in simplest radical form.

   (a) By Completing the Square

   (b) By the Quadratic Formula

3. Solve the equation $2x^2-13x+20=0$ two ways:

   (a) By Factoring

   (b) By the Quadratic Formula

4. If the quadratic formula is used to solve the equation $x^2-4x-41=0$, the correct roots are

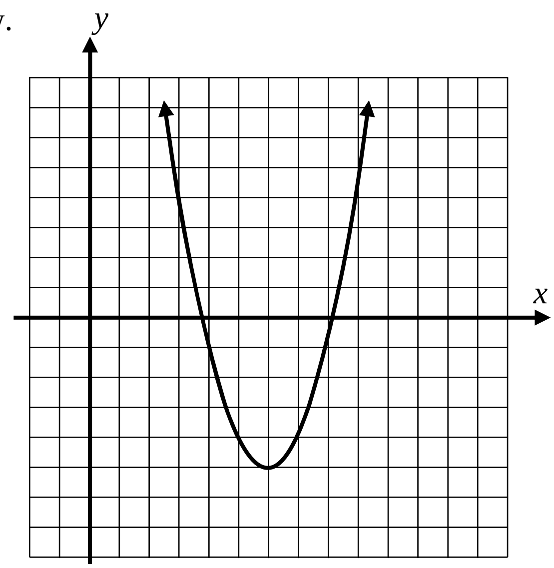
   (1) $4\pm3\sqrt{10}$

   (3) $-4\pm3\sqrt{10}$

   (2) $2\pm3\sqrt{5}$

   (4) $-2\pm3\sqrt{5}$

5. The quadratic function $f(x)=x^2-12x+31$ is shown below.



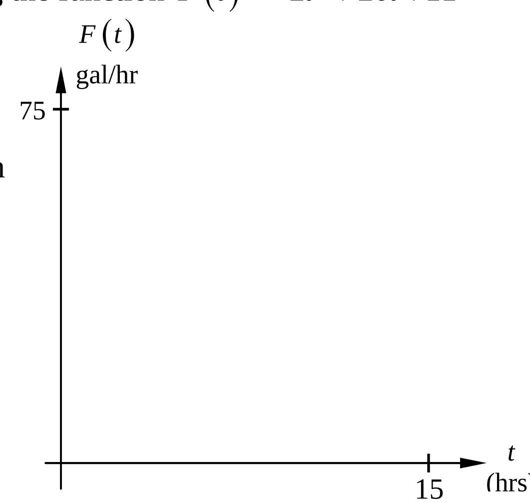
(a) Find the zeroes of this function in simplest radical form by using the quadratic equation.

(b) Write this function in vertex form by completing the square. Based on this, what are the coordinates of its turning point? Verify on the graph.

APPLICATIONS

6. The flow of oil in a pipe, in gallons per hour, can be modeled using the function $F(t)=-2t^2+20t+11$

(a) Using your calculator, graph the function on the axes provided.



(b) Using the quadratic formula, find, to the nearest tenth of an hour, the time when the flow stops (is zero). Show your work.

(c) Use the process of completing the square to write $F(t)$ in its vertex form. Then, identify the peak flow and the time at which it happens.