Note: Have students try to solve $2x^2+8x-5=0$

7.7 Solving Quadratic Equations using the Quadratic Formula

The roots of a quadratic equation in the form $ax^2 + bx + c = 0$, where $a \neq 0$, can be determined by using the quadratic formula

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

Show "Quadratic Song" on YouTube.

The **Quadratic Formula** allows us to find the 'roots', 'zeros' or x-intercepts of **any** quadratic equation, regardless if we can fully factor it or not. However, we often try solving for the x-intercepts by factoring first, as this method is usually quicker.

Example 1: Solve the equation using the **quadratic formula**. (Remember to set the equation equal to zero first!)

$x^2 + 6x = -8$

① set equal to "0"

$x^2+6x+8=0$ (a, b, c)

a=1 b=6 c=+8

$$x = \frac{-6 \pm \sqrt{6^2-4(1)(+8)}}{2(1)}$$

$$x = \frac{-6 \pm \sqrt{36-32}}{2}$$

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

$x = \frac{-6+2}{2}$ $x = \frac{-4}{2}$ $x = -2$

$x = \frac{-6-2}{2}$ $x = \frac{-8}{2}$ $x = -4$

$x = \{-2, -4\}$

Example 2: Solve the quadratic $2x^2 + 8x - 5 = 0$. State your answer as an exact value (leave as a reduced radical).

$a=2$ $b=8$ $c=-5$

$$x = \frac{-8 \pm \sqrt{8^2-4(2)(-5)}}{2(2)}$$

$$x = \frac{-8 \pm \sqrt{64+40}}{4}$$

$$x = \frac{-8 \pm \sqrt{104}}{4}$$ ← simplify the radical

$104 = 4 \cdot 26 = 4 \cdot 2 \cdot 13$

$$x = \frac{-8 \pm \sqrt{4 \cdot 26}}{4}$$

$$x = \frac{-8 \pm 2\sqrt{26}}{4}$$ reduce

$$x = \frac{-4 \pm \sqrt{26}}{2}$$

$x = \left\{\frac{-4+\sqrt{26}}{2}, \frac{-4-\sqrt{26}}{2}\right\}$

Example 3: Find the roots for the quadratic $y = x^2 + 9x + 23$

$0 = x^2 + 9x + 23$

$a = 1 \quad b = 9 \quad c = 23$

$$x = \frac{-9 \pm \sqrt{9^2 - 4(1)(23)}}{2(1)}$$

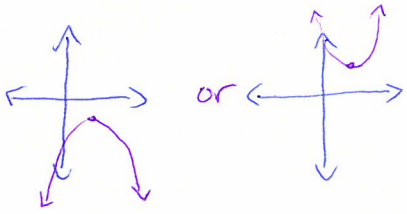
$$x = \frac{-9 \pm \sqrt{81 - 92}}{2}$$

$$x = \frac{-9 \pm \sqrt{-11}}{2}$$

← can't take the square root of a negative so their is no solution.

$x = \{\emptyset\}$ (no solution) or $\{\ \}$ (empty set)

What does this mean about the graph of the corresponding quadratic?

The graph will have no x-intercepts  or

NOTE

- $b^2 - 4ac$ is called the discriminant
  - If the discriminant simplifies to a **perfect square**, then the quadratic equation could also have been solved by factoring.
  - If the discriminant simplifies to a **negative** number, then there is no solution (the parabola will not cross or touch the x-axis).
  - If the discriminant simplifies to **zero**, there is 1 solution (the vertex lies on the x-axis).

Note: If time allows do #2a together

Assignment: page 428 # 1 (solve only), 2,4, 6

Extra Questions: 1) Determine x -intercepts and vertex for each of the following quadratic functions:

a) $y = -x^2 + 6x - 5$ b) $y = \frac{1}{3}x^2 - 2x + 3$

2) Use the quadratic formula to solve each of the following quadratic equations:

a) $x^2 - 2\sqrt{2}x + 2 = 0$ b) $\sqrt{3}x^2 - 7x = -2\sqrt{3}$