Warm Up:

Solve each equation.

$3x^2 + 96 = 0$

$3x^2 = -96$

$x^2 = -32$

$x = \pm\sqrt{-32}$

$x = \pm\sqrt{16}\cdot\sqrt{2}\cdot\sqrt{-1}$

$x = \pm 4\sqrt{2}i$

$x^2 + 8x + 20 = 0$

$x^2 + 8x = -20$

$x^2 + 8x + 16 = -4$

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

5-6 The Quadratic Formula

Objectives

Solve quadratic equations using the Quadratic Formula.

Classify roots using the discriminant.

5-6 The Quadratic Formula

Vocabulary

discriminant

5-6 The Quadratic Formula

You have learned several methods for solving quadratic equations: graphing, making tables, factoring, using square roots, and completing the square. Another method is to use the *Quadratic Formula*, which allows you to solve a quadratic equation in standard form.

By completing the square on the standard form of a quadratic equation, you can determine the Quadratic Formula.

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5-6 The Quadratic Formula

Numbers		Algebra
$3x^2 + 5x + 1 = 0$		$ax^2 + bx + c = 0 \ (a \neq 0)$
$x^2 + \frac{5}{3}x + \frac{1}{3} = 0$	Divide by a.	$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$
$x^2 + \frac{5}{3}x = -\frac{1}{3}$	Subtract $\frac{c}{a}$.	$x^2 + \frac{b}{a}x = -\frac{c}{a}$
$x^2 + \frac{5}{3}x + \left(\frac{5}{2(3)}\right)^2 = -\frac{1}{3} + \left(\frac{5}{2(3)}\right)^2$	Complete the square.	$x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \left(\frac{b}{2a}\right)^2$
$\left(x + \frac{5}{6}\right)^2 = \frac{25}{36} - \frac{1}{3}$	Factor.	$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2}{4a^2} - \frac{c}{a}$
$x + \frac{5}{6} = \pm\sqrt{\frac{13}{36}}$	Take square roots.	$x + \frac{b}{2a} = \pm\sqrt{\frac{b^2 - 4ac}{4a^2}}$
$x = -\frac{5}{6} \pm \frac{\sqrt{13}}{6}$	Subtract $\frac{b}{2a}$.	$x = -\frac{b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a}$
$x = \frac{-5 \pm \sqrt{13}}{6}$	Simplify.	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

5-6 The Quadratic Formula

Remember!

To subtract fractions, you need a common denominator.

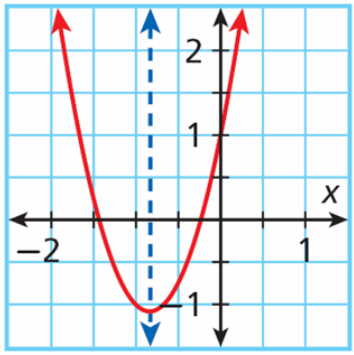
$$\frac{b^2}{4a^2} - \frac{c}{a}$$

$$\frac{b^2}{4a^2} - \frac{c}{a}\left(\frac{4a}{4a}\right)$$

$$\frac{b^2 - 4ac}{4a^2}$$

5-6 The Quadratic Formula

The symmetry of a quadratic function is evident in the last step, $x = -\frac{b}{2a} \pm \frac{\sqrt{b^2 - 4ac}}{2a}$. These two zeros are the same distance, $\frac{\sqrt{b^2 - 4ac}}{2a}$, away from the axis of symmetry, $x = -\frac{b}{2a}$, with one zero on either side of the vertex.



5-6 The Quadratic Formula

The Quadratic Formula

If $ax^2 + bx + c = 0$ $(a \neq 0)$, then the solutions, or roots, are

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

You can use the Quadratic Formula to solve any quadratic equation that is written in standard form, including equations with real solutions or complex solutions.

Knowing the Quadratic Formula is a must. You need to commit this to memory today. It is long but the more you work with it the quicker you will learn it.

Find the zeros of $f(x) = 2x^2 - 16x + 27$ using the Quadratic Formula.

$a: 2$

$b: -16$

$c: 27$

$$x = \frac{16 \pm \sqrt{(-16)^2 - 4(2)(27)}}{2(2)}$$

$$x = \frac{16 \pm \sqrt{256 - 216}}{4}$$

$$x = \frac{16 \pm \sqrt{40}}{4} \qquad \sqrt{40} = \sqrt{4} \cdot \sqrt{10}$$

$$x = \frac{16 \pm 2\sqrt{10}}{4}$$

$$x = \frac{16}{4} \pm \frac{2\sqrt{10}}{4}$$

$$x = 4 \pm \frac{1}{2}\sqrt{10}$$

$4 + \frac{1}{2}\sqrt{10}$

$4 - \frac{1}{2}\sqrt{10}$

Find the zeros of $f(x) = x^2 + 3x - 7$ using the Quadratic Formula.

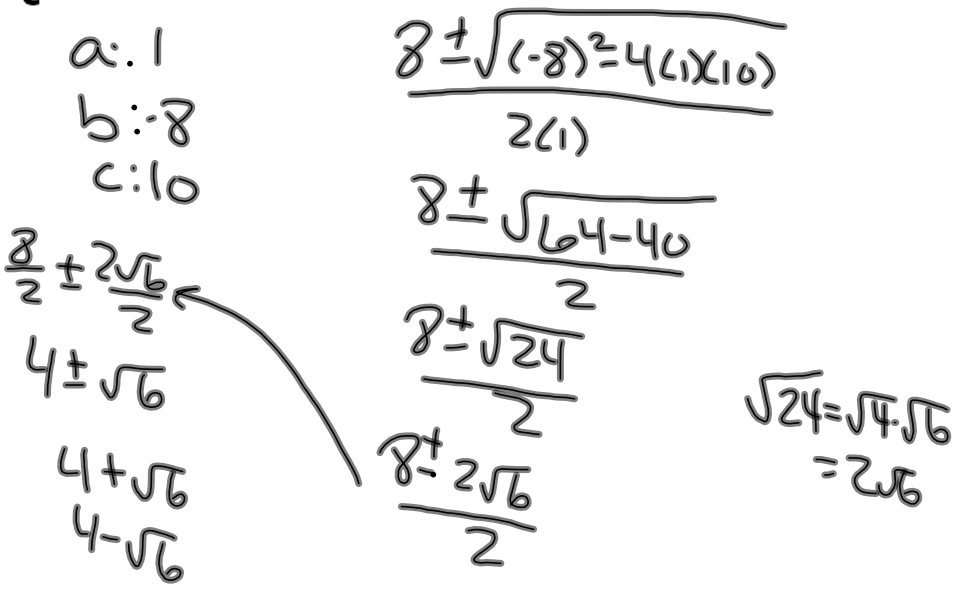
a: 1
b: 3
c: -7

$$\frac{-3 \pm \sqrt{3^2 - 4(1)(-7)}}{2(1)}$$

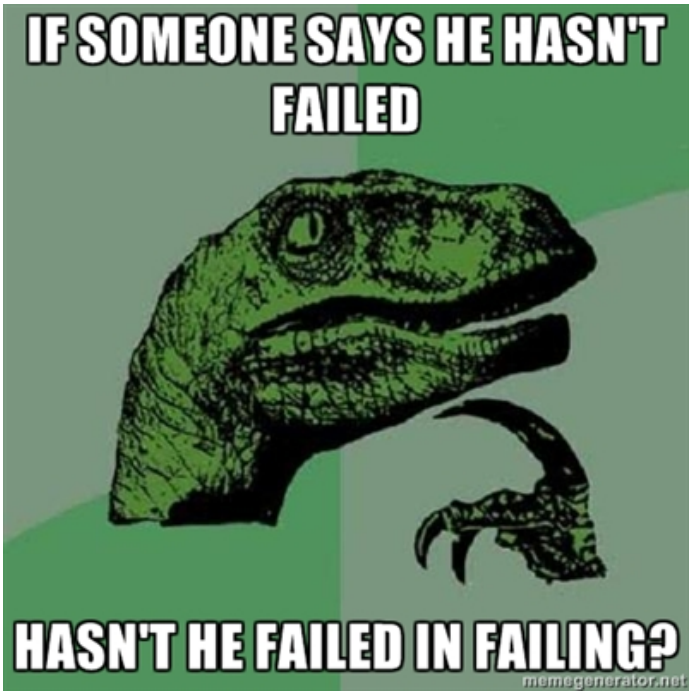
$$\frac{-3 \pm \sqrt{9 - -28}}{2}$$

$$X = -\frac{3 \pm \sqrt{37}}{2}$$

Find the zeros of $f(x) = x^2 - 8x + 10$ using the Quadratic Formula.



Find the zeros of $f(x) = 4x^2 + 3x + 2$ using the Quadratic Formula.



Write your own quadratic and then find the roots using the Quadratic Equation.

Keep this equation and roots on a sheet of paper.

$3x^2-16x+7$

5-6 The Quadratic Formula

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

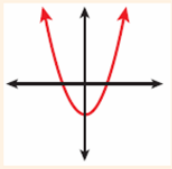
The **discriminant** is part of the Quadratic Formula that you can use to determine the number of real roots of a quadratic equation.

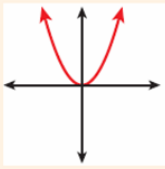
5-6 The Quadratic Formula

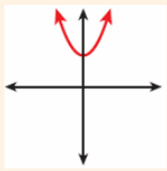
Discriminant

The discriminant of the quadratic equation $ax^2 + bx + c = 0$ $(a \neq 0)$ is $b^2 - 4ac$.

$b^2 - 4ac > 0$	$b^2 - 4ac = 0$	$b^2 - 4ac < 0$
two distinct real solutions	one distinct real solution	two distinct nonreal complex solutions







Caution!

Make sure the equation is in standard form before you evaluate the discriminant, $b^2 - 4ac$.

Find the type and number of solutions for the equation.

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

$x^2 - 12x + 36 = 0$

$(-12)^2 - 4(1)(36)$

$144 - 144$

0

1 real soln

Find the type and number of solutions for the equation.

$$x^2 + 40 = 12x$$

$x^2 - 12x + 40 = 0$

$(-12)^2 - 4(1)(40)$

$144 - 160$

-16

2 complex soln

Find the type and number of solutions for the equation.

$$x^2 + 30 = 12x$$

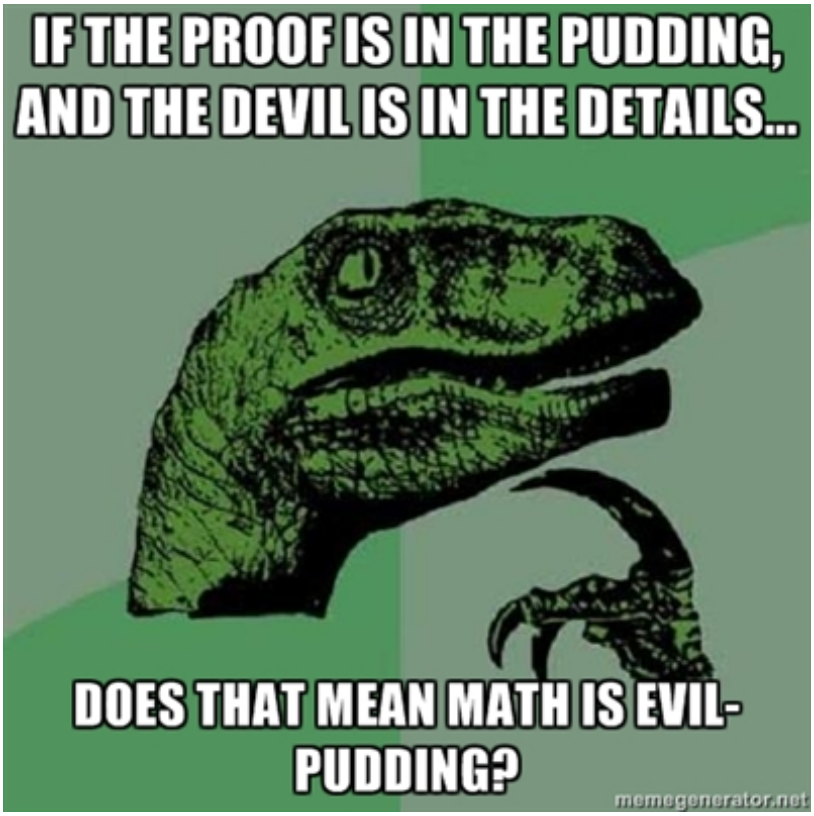
$x^2 - 12x + 30 = 0$

$(-12)^2 - 4(1)(30)$

$144 - 120$

24

2 real soln



Find the type and number of solutions for the equation.

$$x^2 - 4x = -4$$

Find the type and number of solutions for the equation.

$$x^2 - 4x = -8$$

Look back at your equation from before. Knowing your roots, how many solutions does your equation have?

An athlete on a track team throws a shot put. The height y of the shot put in feet t seconds after it is thrown is modeled by $y = -16t^2 + 24.6t + 6.5$. The horizontal distance x in between the athlete and the shot put is modeled by $x = 29.3t$. To the nearest foot, how far does the shot put land from the athlete?

$a = -16$

$b = 24.6$

$c = 6.5$

Homework:

p. 361 #18-27, 30-36, 55, 61-64