Quadratic Formula: $\boxed{x = \frac{-b \pm \sqrt{b^2 - 4(a)(c)}}{2a}}$

Polynomial Equations Day 3 Notes   Notable Student: Key   Date:

Solve $3x^2 + 4x + 4 = 0$.

$a = 3$

$b = 4$

$c = 4$

$$x = \frac{-4 \pm \sqrt{4^2 - 4(3)(4)}}{2(3)} = \frac{-4 \pm \sqrt{16 - 48}}{6} = \frac{-4 \pm \sqrt{-32}}{6}$$

Put $\sqrt{-32}$ into calc.

2 problems: we need to know what it means when we take the square root of a negative number and we need to know how to simplify square roots.

Simplifying Square Roots: Look at the table below and try to fill it out using your calculators to find the decimal approximations.

Radical Expression	Decimal Approximation	Radical Expression	Decimal Approximation
$\sqrt{40}$		$\sqrt{4} \cdot \sqrt{10}$	
$\sqrt{90}$		$\sqrt{9} \cdot \sqrt{10}$	
$\sqrt{98}$		$\sqrt{49} \cdot \sqrt{2}$	
$\sqrt{125}$		$\sqrt{25} \cdot \sqrt{5}$	

What do we notice? What does that tell us about square roots?

Our best friends (perfect squares): 1, 4, 9, 16, 25, 36, 49, 64, 81, 100
1^2 2^2 3^2 4^2 5^2 6^2 7^2 8^2 9^2 10^2

Practice: Simplify the following:

1. $\sqrt{128}$

$128 = 64 \cdot 2$

$\sqrt{64} \cdot \sqrt{2}$

$\sqrt{64} = 8$

$8 \cdot \sqrt{2}$

$8\sqrt{2}$

2. $\sqrt{150}$

3. $\sqrt{196}$

$196 = 49 \cdot 4$

$\sqrt{49} \cdot \sqrt{4}$

$\sqrt{49} = 7$ $\sqrt{4} = 2$

$7 \cdot 2$

14

4. $\sqrt{97}$

Negative Square Roots: What does your calculator say when you enter $\sqrt{-1}$?

Non-real calculation or error

Carl Friedrich Gauss discovered a new set of numbers, the **complex numbers** when trying to figure out the answer to $\sqrt{-1}$. Today we define this as "i" and we say $\sqrt{-1} = i$

We can use this to simplify these radicals:

1. $\sqrt{-36}$

$\sqrt{-1} \cdot \sqrt{36}$

$i \cdot 6$

or

$6i$

2. $\sqrt{-96}$

3. $\sqrt{-245}$

$\sqrt{-1} \cdot \sqrt{245}$

$i \cdot \sqrt{49} \cdot \sqrt{5}$

$i \cdot 7\sqrt{5}$ or $7i\sqrt{5}$

Going back to our original problem: Solve $3x^2 + 4x + 4 = 0$.

$\sqrt{-32}$

$i\sqrt{16} \cdot \sqrt{2}$

$4i\sqrt{2}$

$$X = \frac{-4 \pm \sqrt{-32}}{6} = \frac{-4 \pm 4i\sqrt{2}}{6} = \frac{-4}{6} \pm \frac{4i\sqrt{2}}{6} = \frac{-2}{3} \pm \frac{2i\sqrt{2}}{3}$$

$\frac{-2}{3} + \frac{2i\sqrt{2}}{3}$ and $\frac{-2}{3} - \frac{2i\sqrt{2}}{3}$

Practice: Solve the following:

1. $5x^2 - 2x + 5 = 0$

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

3. $9x^2 - 4x + 2 = 0$