Warm-Up:

Consider the system of equations below. Find the solution.

$y = x^2 - 2x + 3$

$y = -x + 5$

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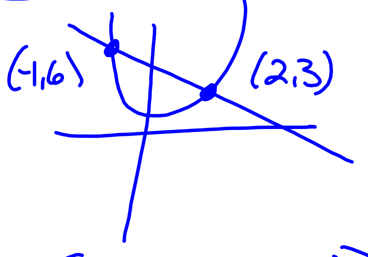
$y_1 =$ $y = x^2 - 2x + 3$

$y_2 =$ $y = -x + 5$

Algebraically

$$-x+5 = x^2-2x+3$$
$$+x-5 \quad\quad +x-5$$
$$x^2-x-2=0$$
$$(x-2)(x+1)=0$$
$$x=2 \quad | \quad x=-1$$
$$y=-2+5 \quad | \quad y=-(-1)+5$$
$$y=3 \quad | \quad y=6$$
$$\{(2,3),(-1,6)\}$$

OR graphically



$$\{(2,3),(-1,6)\}$$

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The number i

Algebra 2 Unit 4 Day 1

On your own, solve each equation for **x**.

1. $x - 1 = 0$ $x = 1$
2. $x + 1 = 0$ $x = -1$
3. $x^2 - 1 = 0$ $\sqrt{x^2} = \pm\sqrt{1}$ $x = \pm 1$
4. $x^2 + 1 = 0$ $\sqrt{x^2} = \sqrt{-1}$ $x = \pm\sqrt{-1}$
5. $x^2 + 2 = 0$ $\sqrt{x^2} = \sqrt{-2}$ $x = \pm\sqrt{-2}$

non real answer

(4) $x^2 + 1 = 0$
$\sqrt{x^2} = \pm\sqrt{-1}$
$x = \{\pm i\}$

(5) $\sqrt{x^2} = \pm\sqrt{-2}$
$x = \{\pm i\sqrt{2}\}$

Which ones above do not have a real number solution? Why?

4 & 5, b/c we can't take the $\sqrt{\ }$ of a negative # in the real # system

Sep 1-1:53 PM

In fact, solving the equation $x^2 + 1 = 0$, we got $x = \pm\sqrt{-1}$.

This leads to i = $\sqrt{-1}$.

Problem: There is no real number that is the square root of a negative real number.

Solution: The number i.

We let $\sqrt{-1} = i$, then $i^2 = -1$.

$(\sqrt{-1})^2 = -1$

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

If $r > 0$, $\sqrt{-r} = \sqrt{-1} \cdot \sqrt{r} = i\sqrt{r}$

$\mathbb{R}$

Definition: A pure imaginary number is a number that can be written in the form bi where $b \in \mathbb{R}$ and $i = \sqrt{-1}$
$b \neq 0$

b is an element of the real # system

Jun 30-9:40 AM

$2x+3x=5x$
$2i+3i=5i$

Rules of i:

1. Change all expressions of the form $\sqrt{-b}$ to $i\sqrt{b}$ first
2. Treat i as a variable for addition and subtraction.
3. Substitute -1 for i^2

$\sqrt{x^2}=\pm\sqrt{9}$ $\quad \pm\sqrt{9}$ $\quad \sqrt{} = +\sqrt{}$

Simplify:

1. $\sqrt{-9} = i\sqrt{9} = 3i$
2. $-\sqrt{-100} = -i\sqrt{100} = -10i$
3. $\sqrt{-20} = i\sqrt{4}\sqrt{5} = 2i\sqrt{5}$
4. $2\sqrt{-27} = 2i\sqrt{9}\sqrt{3} = 6i\sqrt{3}$

Note: In the real number system $\sqrt{a}\bullet\sqrt{b}=\sqrt{a\bullet b}$. However, this is not the case when working with imaginary numbers.

Example: Simplify the following using a)rules for real numbers and then b)rules for i.

$\sqrt[3]{\text{radicand}}$ ← index

a) $\sqrt{-4}\bullet\sqrt{-25}$
$=\sqrt{-4\cdot -25}$
$=\sqrt{100}$
$=10$

b) $\sqrt{-4}\bullet\sqrt{-25}$
$= i\sqrt{4}\cdot i\sqrt{25}$
$= 2i\cdot 5i$
$= 10i^2$
$= 10(-1) = -10$

$i^2=-1$

What do you notice?
The answers are opposites

Simplify:

5. $\sqrt{-9}\bullet\sqrt{-16} = i\sqrt{9}\cdot i\sqrt{16} = 3i\cdot 4i = 12i^2 = 12(-1) = -12$
6. $\sqrt{5}\bullet\sqrt{-10} = \sqrt{5}\cdot i\sqrt{10} = i\sqrt{50} = i\sqrt{25}\sqrt{2} = 5i\sqrt{2}$
7. $-\sqrt{-6}\bullet\sqrt{15} = -i\sqrt{6}\cdot\sqrt{15} = -i\sqrt{90} = -i\sqrt{9}\sqrt{10} = -3i\sqrt{10}$
8. $(\sqrt{-7})^2 = \sqrt{49} = 7$

$(i\sqrt{7})^2 = i\sqrt{7}\cdot i\sqrt{7} = i^2\sqrt{49} = i^2\cdot 7 = 7i^2 = 7(-1) = -7$
$(\sqrt{-7})^2 = -7$