Warm Up

Simplify the following expressions

Thursday, February 5, 2015

1. $\sqrt{98}$

2. $\sqrt{864x^3y^4}$

3. $\sqrt{90q^7}$

Quadratic Formula

Objectives Use the properties of imaginary numbers to simplify expressions.

Use the Discriminant to determine the number and type of roots for a quadratic function.

Homework 4-8 Practice, 1, 3, 5, 10-27 odd

Quadratic Formula

THE QUADRATIC FORMULA

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

Quadratic Formula

Let’s sing!

Solve **$x^2 + 4x = 12$** using the **quadratic formula**.

Step 1: Put the equation in standard form. $x^2 + 4x - 12 = 0$

Step 2: Find the values of a, b, and c. $a = 1, b = 4, c = -12$

Step 3: Substitute a, b, and c into the formula

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

$$x = \frac{-4 \pm \sqrt{4^2 - 4(1)(-12)}}{2(1)}$$

Step 4: Simplify

$$x = \frac{-4 \pm \sqrt{16 + 48}}{2} = \frac{-4 \pm \sqrt{64}}{2} = \frac{-4 \pm 8}{2} = \frac{-4}{2} \pm \frac{8}{2} = -2 \pm 4$$

Step 5: Final answer(s) $-2 + 4 = \mathbf{2}\ and\ -2 - 4 = \mathbf{-6}$

Solve $x^2 + 2x = -5$ using the **quadratic formula**.

Step 1: Put the equation in standard form.

Step 2: Find the values of a, b, and c.

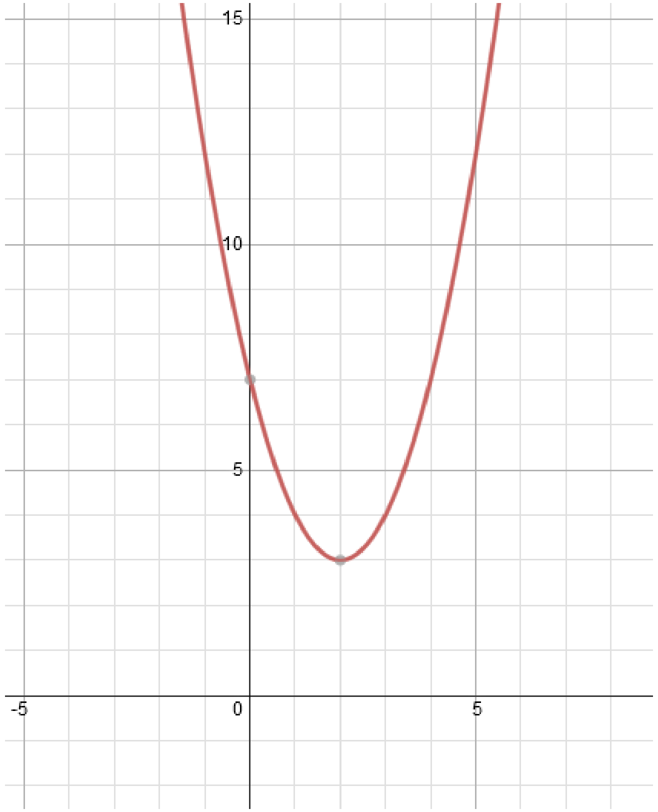
Step 3: Substitute a, b, and c into the formula

Step 4: Simplify

Step 5: Determine final answer(s)

Using the quadratic formula causes us to take the square root of a negative.

What does this mean "no real roots"?



Graphically we know it means that there are **no x intercepts**.

Algebraically this means we have **complex roots**.

Let's talk about *imaginary numbers*.

Home for imaginary numbers…

Remember getting your hand slapped when you tried to take the square root of a negative number?

Well thanks to imaginary numbers, you'll never have to worry about that again.

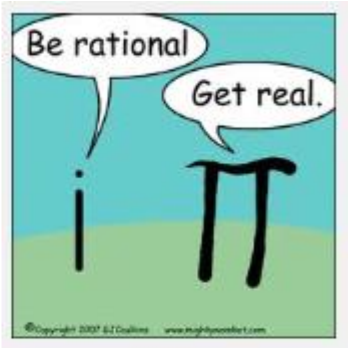
Now we'll starting thinking like this…

$$\sqrt{-4} = \sqrt{(-1)(4)} = 2\sqrt{-1}$$

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

But we're going to let the symbol i represent $\sqrt{-1}$ and write

$$\sqrt{-4} = 2i$$



Remember, i is a number like π and e

π is the ratio between circumference and diameter shared by all circles.

e is the base rate of growth shared by all continually growing processes.

i is the is the square root of negative 1.

We can perform mathematical operations on i.

$$i^0 = 1$$

$$i^1 = \sqrt{-1} = i$$

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

$$i^3 = (i^2)(i) = (-1)(i) = -i$$

Simplifying numbers using i

Write $\sqrt{-18}$ using the imaginary unit.

Simplifying numbers using i

Write $\sqrt{-25}$ using the imaginary unit.

Write $\sqrt{-12}$ using the imaginary unit.

Write $\sqrt{-7}$ using the imaginary unit.


But wait!
There's more!
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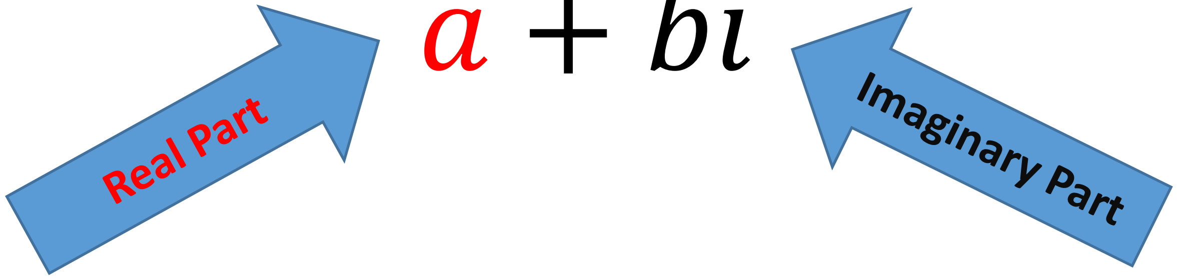
Complex Numbers, *not so complex*

$$a + bi$$



a and b are real numbers

If $a = 0$ the number is $a + bi$ is a **pure imaginary number**

If $a \neq 0$ and $b = 0$ the number is $a + bi$ is a **real number**

If $a \neq 0$ and $b \neq 0$ the number is $a + bi$ is a **complex number**

A little math humor.

After having dinner together a one mathematician asked the other “How was your meal”?

“Great but $\frac{\sqrt{-1}}{8}$.”

“Yeah,” said the other, “I over 8 too.”

Adding and subtracting Complex Numbers

Simplify $(4 - 3\mathrm{i}) + (-4 + 3\mathrm{i})$

Simplify $(5 - 3\mathrm{i}) - (-2 + 4\mathrm{i})$

Find Each sum or difference

1. $(7 - 2i) + (-3 + i)$

2. $(1 + 5i) - (3 - 2i)$

3. $(8 + 6i) - (8 - 6i)$

4. $(-3 + 9i) + (3 + 9i)$

Multiplying Complex Numbers

Simplify $(3\mathrm{i})(-5 + 2\mathrm{i})$

Simplify $(4 + 3\mathrm{i})(-1 - 2\mathrm{i})$

Find Each Product

1. $(7i)(3i)$

2. $(2 - 3i)(4 + 5i)$

3. $(-4 + 5i)(-4 - 5i)$

What did you notice about the last problem?

$$(-4 + 5i)(-4 - 5i)$$

The product was a real number.

Both terms in each factor are identical.

The sign (or operation) in each factor is the opposite of the other factor.

We call these **conjugates**. In this case, they are **complex conjugates**.

Dividing Complex Numbers

Simplify $\frac{2+3i}{1-4i}$

Multiply numerator and denominator by the complex conjugate of the denominator, $1 + 4\mathrm{i}$.

Substitute -1 for i^2

Dividing Complex Numbers

Simplify $\frac{9+12i}{3i}$

Multiply numerator and denominator by the complex conjugate of the denominator, $-3i$.

Substitute -1 for i^2

Find Each Quotient

1. $\frac{5-2i}{3+4i}$

2. $\frac{4-i}{6i}$

3. $\frac{8-7i}{8+7i}$

Quadratic Formula

Let's look at this one again. Use the quadratic formula to find the roots of this equation.

$$3x^2 - 4x + 10 = 0$$

Complex roots always come in pairs!

Quadratic Formula

Find the discriminant of each equation and determine the number of real solutions.

1. $-x^2 + 2x - 9 = 0$

2. $x^2 + 17x + 4 = 0$

3. $x^2 - 6x + 9 = 0$

Quadratic Formula

To Turn In …

Solve the following equations using the Quadratic Formula.

1. $x^2 + 12x + 35 = 0$

2. $2x^2 + 3 = 7x$