Multiply Complex Numbers

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WHAT'S COVERED

In this lesson, you will learn how to multiply two complex numbers. Specifically, this lesson will cover:

1. Complex Numbers
2. FOIL Review
3. Multiplying Complex Numbers

1. Complex Numbers

A complex number is a number in the form $a+bi$, containing both a real part and an imaginary part. The imaginary part is followed by *i*, which is the imaginary unit, $\sqrt{-1}$.

Recall the following formulas for imaginary numbers:

FORMULA TO KNOW

Imaginary Number

$i=\sqrt{-1}$

$i^2=-1$

When multiplying complex numbers, we follow a similar process when multiplying binomial factors we may be familiar with when studying quadratics. The multiplication process is often referred to as FOIL, which distributes terms into the factors being multiplied. Let's take a moment to review FOIL with real numbers before looking at examples of complex number multiplication.

2. FOIL Review

FOIL stands for First, Outside, Inside, Last, and refers to terms that are multiplied together to form individual addends to the product.

EXAMPLE Multiply $(x+2)(x-3)$.

$(x+2)(x-3)$	Multiply first terms: $x \cdot x = x^2$
x^2	Multiply outside terms: $x \cdot -3 = -3x$
$x^2 - 3x$	Multiply inside terms: $2 \cdot x = 2x$
$x^2 - 3x + 2x$	Multiply last terms: $2 \cdot -3 = -6$
$x^2 - 3x + 2x - 6$	Combine like terms
$x^2 - x - 6$	Our solution

When multiplying two complex numbers, we will be following the same procedure but will need to make an additional consideration when the imaginary unit is squared.

3. Multiplying Complex Numbers

When multiplying complex numbers, we'll want to consider the imaginary unit, *i*.

EXAMPLE Multiply the complex numbers $(2+3i)(4+2i)$.

$(2+3i)(4+2i)$	Multiply first terms: $2 \cdot 4 = 8$
8	Multiply outside terms: $2 \cdot 2i = 4i$
$8 + 4i$	Multiply inside terms: $3i \cdot 4 = 12i$
$8 + 4i + 12i$	Multiply last terms: $3i \cdot 2i = 6i^2$
$8 + 4i + 12i + 6i^2$	Combine like terms
$8 + 16i + 6i^2$	Simplify i^2

The final step here is to simplify the last term, containing the imaginary unit squared. Recall that the imaginary unit is $\sqrt{-1}$. When this is squared, it becomes the real number -1.

To simplify i^2 terms, we can remove i^2 completely, but reverse the sign of its coefficient. For example, $+6i^2$ simplifies to -6. This is a real number that can be combined with other like terms.

$8 + 16i + 6i^2$	Rewrite $+6i^2$ as -6
$8 + 16i - 6$	Combine like terms
$2 + 16i$	Our solution

BIG IDEA

To multiply complex numbers, we use the FOIL process to multiply the terms in the two complex numbers. During this process, we simplify i^2 to -1, which is a real number.

SUMMARY

Complex numbers consist of a real part and an imaginary part. The square root of negative 1 is imaginary because no real number squared results in a negative number. Because complex numbers are binomials, use **FOIL** when Complex numbers consist of a real part and an imaginary part. The square root of negative 1 is imaginary because no real number squared results in a negative number. Because complex numbers are binomials, use FOIL when **multiplying complex numbers**. Simplify expressions with an *i* squared term by substituting negative 1 for *i* squared, multiplying by the coefficient, and writing as a real number with the opposite sign.

FORMULAS TO KNOW

Imaginary Number

$i = \sqrt{-1}$

$i^2 = -1$