

Multiplying Binomials

by Sophia



WHAT'S COVERED

This tutorial covers multiplying binomials, through the definition and discussion of:

1. [The Distributive Property: A Review](#)
2. [Multiplying Binomials Using FOIL](#)
3. [Multiplying Binomials Squared Using FOIL](#)

1. The Distributive Property: A Review

In review, the distributive property is used when simplifying an expression such as:

$$8x^2(2x^3 - 1)$$

Using the distributive property, you would distribute the outside expression, $8x^2$, to both terms inside the parentheses. Therefore, you would first multiply $8x^2$ by the first term, noting that because both of the bases are x , you can add your exponents. Next, multiply $8x^2$ by your second term, -1 . Thus, your final answer is:

$$\begin{aligned} 8x^2(2x^3 - 1) &= \\ 16x^5 - 8x^2 \end{aligned}$$

Your answer is in standard form, or descending order according to the exponents in each term.

2. Multiplying Binomials Using FOIL

Suppose you want to multiply two binomials:

$$(3x + 3)(2x - 4)$$

To multiply binomials, you need to distribute *twice*, multiplying the $3x$ by both terms in the second parentheses, following by multiplying the 3 by both terms in the second parentheses. Note that $3x$ and $2x$ both have implied exponents of 1.

$$(3x)(2x) + (3x)(-4) + (3)(2x) + (3)(-4)$$

When distributing, you will write all terms as a single expression—adding terms with positive coefficients and subtracting terms with negative coefficients. Therefore, you can combine the like terms, $-12x$ and $6x$, which equals $-6x$, providing your final answer:

$$6x^2 + (-12x) + 6x + (-12) = \\ 6x^2 - 6x - 12$$

You can remember this method of multiplying binomials by using the acronym “FOIL,” which stands for “First, Outside, Inside, and Last.”

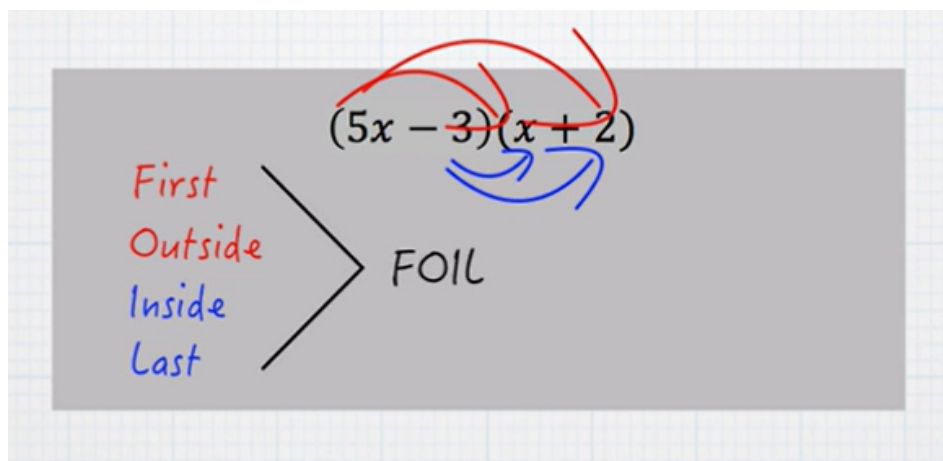


FORMULA TO KNOW

FOIL Method

$$(a + b)(c + d) = ac + ad + bc + bd$$

In the preceding example, you distributed by multiplying the first two terms in each parentheses and then the outside terms. You then distributed by multiplying the inside terms and then the last two terms in each parentheses. Therefore, you can use the acronym **FOIL** to remember the steps for distributing factors in binomial multiplication.



⇒ **EXAMPLE** Use FOIL to multiply these two binomials:

$$(5x - 3)(x + 2)$$

First: Multiply the first terms, $5x$ times x , which will give you $5x^2$.

Outside: Multiply the outside terms, $5x$ times 2 , which equals $10x$.

Inside: Multiply the inside terms, -3 times x , which equals $-3x$.

Last: Multiply -3 times 2 , which equals -6 .

Put it all together:

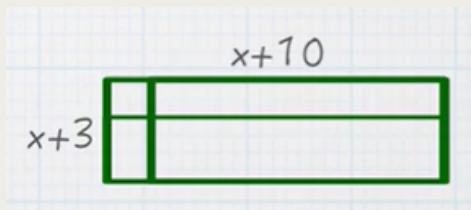
$$(5x - 3)(x + 2) =$$
$$5x^2 + 10x - 3x - 6$$

Finally, combine the like terms, $10x$ and $-3x$, to arrive at your final answer:

$$5x^2 + 7x - 6$$

IN CONTEXT

Suppose a farmer wants to plant a small area for a new chicken pen. The length and width of the pen are shown below. What is the area of the chicken pen in terms of x ?



To find the area of the pen, you want to multiply the length and the width, which would be expressed as:

$$(x + 3)(x + 10)$$

These are binomials multiplied together, so you can multiply using FOIL:

F Your first two terms, x and x , multiply together to give you x^2 .

O Your outside terms, x times 10 , equal $10x$.

I Multiplying your inside terms, 3 and x , equals $3x$.

L Lastly, multiplying your last terms, 3 and 10 , equals 30 .

$$x^2 + 10x + 3x + 30$$

You can combine your like terms, $10x$ and $3x$. Therefore, the area of the chicken pen can be written as:

$$x^2 + 13x + 30$$



TRY IT

Consider the following binomials. Note that one of these binomials includes an exponent.

$$(2x^2 + 4x)(3x + 2)$$

Use FOIL to multiply the two binomials.

+

F Multiply your first terms together, $2x^2$ times $3x$.

O Multiply your outside terms, $2x^2$ times 2 .

I Multiply your inside terms, $4x$ times $3x$.

L Multiply your last terms, $4x$ times 2 .

Combine your like terms to provide your final expression:

$$\begin{aligned}(2x^2 + 4x)(3x + 2) &= \\ 6x^3 + 4x^2 + 12x^2 + 8x &= \\ 6x^3 + 16x^2 + 8x &\end{aligned}$$



TERM TO KNOW

FOIL

An acronym to remember the steps for distributing factors in binomial multiplication: first, outside, inside, last

3. Multiplying Binomials Squared Using FOIL

Suppose you want to simplify:

$$(x - 5)^2$$

This is an example of a binomial squared, and it means the same as:

$$(x - 5)(x - 5)$$

You can multiply binomials squared in the same manner as other binomials, using FOIL: multiply your first two terms, your outside terms, your inside terms and finally, your last terms:

$$\begin{aligned}(x - 5)(x - 5) &= \\ x^2 - 5x - 5x + 25 &\end{aligned}$$

Combine your like terms, $-5x$ and $-5x$, to provide your final expression:

$$x^2 - 10x + 25$$



SUMMARY

Today you reviewed **the distributive property** and how to use it when **multiplying binomials**. You learned about the acronym **FOIL**, which is used to remember the steps for distributing factors in binomial multiplication: First, Outside, Inside, and Last. Lastly, you learned how to use foil when **multiplying binomials squared**.

Source: This work is adapted from Sophia author Colleen Atakpu.



TERMS TO KNOW

FOIL

An acronym to remember the steps for distributing factors in binomial multiplication: first, outside, inside, last.



FORMULAS TO KNOW

FOIL Method

$$(a + b)(c + d) = ac + ad + bc + bd$$