Multiplying Terms using Distribution

by Sophia

WHAT'S COVERED

This tutorial covers how to multiply terms using distribution, through the definition and discussion of:

1. Monomials, Binomials, and Polynomials

A **monomial** is an exponential expression that consists of one term with non-negative integer exponents—“mono” meaning “one.”

EXAMPLE Below is an example of a monomial. In this term, 4 is the coefficient, x is the base, and 5 is the exponent.

$4x^5$

A **binomial** is an expression that consists of two monomial terms—“bi” meaning “two.”

EXAMPLE Below is an example of a binomial.

$3y^3 - 2x^6$

Lastly, a **polynomial** is an expression that consists of two or more monomial terms—“poly” meaning “many.”

EXAMPLE Below is an example of a polynomial. Expressions should always be simplified by combining like terms if possible, so in this polynomial, you can combine the like terms 4a and 2a.

$$5a^3 + 4a - 3a^2 + 2a$$
$$5a^3 - 3a^2 + 6a$$

TERMS TO KNOW

Monomial

An exponential expression with non-negative integer exponents

Binomial

An expression containing two monomial terms

Polynomial

An expression containing two or more monomial terms

2. The Distributive Property

The distributive property is where the quantity that is outside of the parentheses is multiplied or distributed into every term inside the parentheses.

FORMULA TO KNOW

Distributive Property

$a(b+c) = ab + ac$

EXAMPLE Suppose you want to simplify the following expression. You would distribute by multiplying the 7 to *both* the x and the -4 in the parentheses.

$$7(x-4) =$$
$$7x - 28$$

3. Multiplying Monomials and Binomials

When multiplying a monomial by a binomial, the entire monomial is distributed, including the coefficients and the variable powers.

EXAMPLE Suppose you want to multiply the following expression:

$$4m^3(5m^2 + 2m)$$

Because your variable bases are the same, you can use the product property for exponents to add your exponents together when multiplying the variable powers together.

To multiply, you will use the distributive property to multiply $4m^3$ by the terms within the parentheses.

$$(4m^3)(5m^2) + (4m^3)(2m)$$

When you multiply $4m^3$ by $5m^2$, you can use the commutative property of multiplication to rewrite the product by grouping your coefficients together and your variable powers together. Similarly, when you multiply $4m^3$ by 2m, you can again use the commutative property of multiplication to rewrite your product.

$$(4\cdot5)(m^3\cdot m^2)+(4\cdot2)(m^3\cdot m)$$

To simplify your first term, multiply your coefficients, 4 and 5, which equals 20. Next, use the product property of exponents to add your exponents together.

$$(4\cdot5)(m^3\cdot m^2)=20m^5$$

Simplifying your second term, multiply your coefficients, 4 times 2, which equals 8. Note that your variable m has no written exponent, which means that it has an implied exponent of 1. Therefore, adding your exponents together provides:

$$(4\cdot2)(m^3\cdot m)=8m^4$$

Bringing your two terms back together, your final expression is in standard form because the term with the highest exponent power is written first, followed by the term with the next highest exponent power, and so on.

$$20m^5+8m^4$$

DID YOU KNOW

You can also call the standard form of a polynomial “descending order.”

Now, using what you’ve learned, try multiplying the following monomial and binomial terms.

TRY IT

Consider the following expression:

$$-2x^2(3x^6-x)$$

Multiply the terms together. +

You need to multiply $-2x^2$ by both terms in the parentheses.

$$(-2x^2)(3x^6)+(-2x^2)(-x)$$

Next, multiply $-2x^2$ by the first term in the parentheses.

$(-2x^2)(3x^6) = -6x^8$

Then, multiply $-2x^2$ times your second term, -x.

$(-2x^2)(-x) = 2x^3$

Bringing the two terms back together, here is your resulting expression:

$-6x^8 + 2x^3$

It is in standard form or descending order, so this is your final answer.

---

4. Multiplying Monomials and Polynomials

The same rules apply when multiplying monomials with polynomials.

EXAMPLE Consider the expression below.

$3(2a^2 + a^3b^2 - b)$

You need to distribute the 3 on the outside of the parentheses to all three terms within the parentheses. Notice that the 3 does not have any variable bases or exponents, so you only need to multiply the coefficients. Also, remember that there is an implied -1 being multiplied by the b here.

$$3(2a^2 + a^3b^2 - b) =$$
$$6a^2 + 3a^3b^2 - 3b$$

Now you must reorder your terms so that they are in descending order, so you'll need to switch the first and second terms to arrive at your final answer.

$3a^3b^2 + 6a^2 - 3b$

EXAMPLE Consider the expression below.

$7x^2y^3(2x^5 - 5x^2y^2 + 3y^3)$

For this last example, you'll need to multiply the term on the outside by each of the three terms inside the parentheses. Note that the outside term contains variables, coefficients, and exponents.

Begin by multiplying the outside term by the first term in the parentheses. 7 times 2 is 14, and you can also add the exponents of x^2 and x^5 because their bases are both x; y^3 stays unchanged. Next, multiply the outside term by your second and third term in the parentheses. Your expression is in standard form or descending order, so this is your final answer:

$$7x^2y^3(2x^5 - 5x^2y^2 + 3y^3) =$$
$$14x^7y^3 - 35x^4y^5 + 21x^2y^6$$

SUMMARY

Today your learned the definitions of **monomials**, **binomials**, and **polynomials**. You also reviewed **the distributive property**, and learned how to apply it when **multiplying monomials by binomials and polynomials**, keeping in mind that the entire monomial is distributed, including coefficients and variable powers.

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

TERMS TO KNOW

Binomial
An expression containing two monomial terms.

Monomial
An exponential expression with non–negative integer exponents.

Polynomial
An expression containing two or more monomial terms.

FORMULAS TO KNOW

Distributive Property
$a(b + c) = ab + ac$