Multiplying Terms using Exponent Properties

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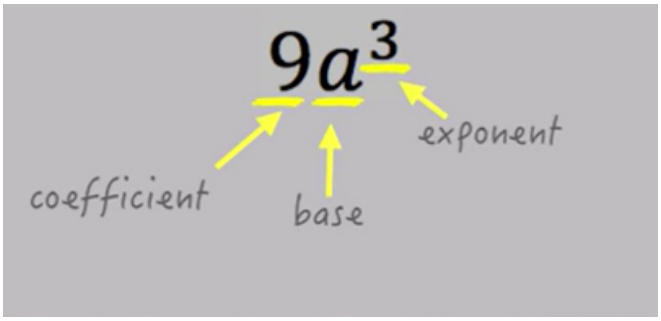
WHAT'S COVERED

This tutorial covers multiplying terms using exponent properties, through the exploration of:

1. Components of Exponential Expressions
2. Product and Power Properties of Exponents
3. Multiplying Terms Using Exponent Properties

1. Components of Exponential Expressions

In review, there are three components of exponential expressions: the base, the coefficient, and the exponent. In the term below, the a is the base, the 9 is the coefficient, and the 3 is the exponent or power.



2. Product and Power Properties of Exponents

You may recall the **product property of exponents**, shown below, which states that when you multiply exponential terms with the same base, you can add their exponents to simplify.

FORMULA TO KNOW

Product Property of Exponents

$$(x^m)(x^n) = x^{(m+n)}$$

EXAMPLE As shown below, when you multiply these two exponential terms, since they have the same base, you can add simply add their exponents.

$$(x^2)(x^7) = x^{(2+7)} = x^9$$

The second property, the **power property of exponents**, states that when taking the power of an exponential expression, the exponents are multiplied, as shown below:

FORMULA TO KNOW

Power Property of Exponents

$$(x^m)^n = x^{m \cdot n}$$

EXAMPLE Consider the expression:

$$(x^4)^3$$

It is the same as:

$$(x^4)(x^4)(x^4)$$

You can use the product property of exponents to add the fours together—$4+4+4$—which equals 12.

$$(x^4)^3 = (x^4)(x^4)(x^4) = x^{(4+4+4)} = x^{12}$$

We could also use the power property to multiply the exponents, which in this case, would be 4 times 3.

$$(x^4)^3 = x^{(4 \cdot 3)} = x^{12}$$

Either way, the expression is equal to x^{12}.

KEY CONCEPT

When using the power property, you sometimes need to multiply fractional exponents. This involves multiplying across the numerators and denominators of the fractions. Fractions are reduced by canceling common factors of the numerator and denominator.

3. Multiplying Terms Using Exponent Properties

Suppose you want to simplify the expression:

$$\left(x^{\frac{1}{2}}\right)^{\frac{2}{3}}$$

The power property of exponents can be used to multiply the two fractional exponents to get a single exponent.

$$x^{\left(\frac{1}{2}\cdot\frac{2}{3}\right)}$$

Remember, when you multiply fractions, you multiply straight across—numerator by numerator and denominator by denominator. Therefore, you have the following, which can be simplified because 2 is a common factor of both 2 and 6. Dividing the numerator and denominator by 2 gives us 1/3.

$$x^{\left(\frac{1}{2}\cdot\frac{2}{3}\right)}=x^{\frac{2}{6}}=x^{\frac{2\div 2}{6\div 2}}=x^{\frac{1}{3}}$$

Now, use what you've learned about the product and power properties of exponents to simplify a more complicated expression.

TRY IT

Consider the following expression:

$$\left(x^{\frac{3}{5}}\cdot x^{\frac{7}{10}}\right)^{\frac{1}{2}}$$

Simplify this expression. +

Start by simplifying in your parentheses. You have two exponential terms multiplying together, and they both have a base of x; therefore, you can use the product property of exponents, and add your exponents together. In this case, your exponents are fractions, so to add them, you need a common denominator. The least common denominator of 5 and 10 is 10. Multiply your first fraction by 2 in the denominator and the numerator, and leave your second fraction unchanged. Now that your denominator is the same, you can add your numerators.

$$\frac{3}{5}+\frac{7}{10}=\frac{3\cdot 2}{5\cdot 2}+\frac{7}{10}=\frac{6}{10}+\frac{7}{10}=\frac{13}{10}$$

Your expression becomes:

$$\left(x^{\frac{3}{5}} \cdot x^{\frac{7}{10}}\right)^{\frac{1}{2}} = \left(x^{\frac{13}{10}}\right)^{\frac{1}{2}}$$

You can now use the power property to multiply 13/10 and 1/2, multiplying straight across, numerator by numerator and denominator by denominator. You don't need to simplify the fraction because 13 and 20 do not have any common factors other than 1:

$$x^{\left(\frac{13}{10} \cdot \frac{1}{2}\right)} = x^{\frac{13}{20}}$$

SUMMARY

Today you reviewed the three **components of an exponential expression**: coefficients, bases, and exponents. You also learned about two properties of exponents: the **product property of exponents**, which states that when multiplying exponential terms together with the same base, the exponents are added; and the **power property of exponents**, which states that when taking the power of an exponential expression, the exponents are multiplied. Finally, you practiced **multiplying terms using exponent properties**.

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

FORMULAS TO KNOW

Power Property of Exponents

$$(x^m)^n = x^{m \cdot n}$$

Product Property of Exponents

$$(x^m)(x^n) = x^{(m+n)}$$