Multiplying Monomials

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9.5 Multiplying Monomials

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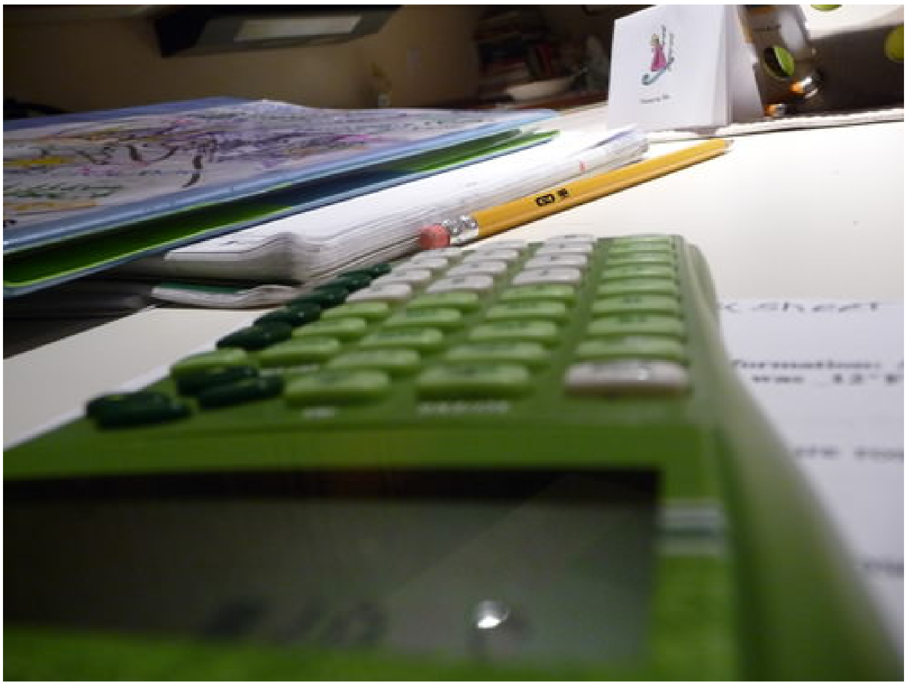


[Figure 1]

Jenny was trying out for the junior Math Olympiad at her school. She was doing very well until the judges gave her the following question to multiply.

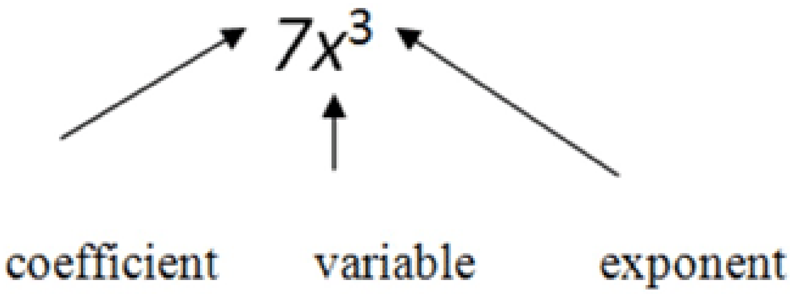
$$(6y^3)(8y^5)(-1xy)$$

Jenny was so confused by the question that she asked the judges to mark that question as her free pass. Can you help Jenny figure out the answer to her free pass question?

In this concept, you will learn to multiply monomials.

Multiplying Monomials

The parts of a term play a major role in multiplying monomials correctly.



[Figure 2]

In the monomial above, the 7 is called the **coefficient**, the x is the **variable**, and the 3 is the **exponent**.

You can say that the monomial $7x^3$ has a **power** of 3 or is to the 3rd power.

If there is no visible coefficient in front of the variable, then the coefficient is an unwritten 1. You could write "$1x$" but it is not necessary. Similarly, if there is no exponent on a coefficient or variable, then you can think of it as having an unwritten exponent of 1. So 7 could be written as 7^1. The constant 7 then, is to the 1st power.

Also, the exponent is applied to the constant, variable, or quantity that is directly to its left. That value is called the **base**. In the monomial above, the base is x. The exponent, in this case, is not applied to the 7 because it is not directly to the left of the exponent.

What is the **exponent**? It's a way of writing many multiplications in a simpler way. In the monomial above, $7x^3$, the 3 indicates that the variable x is multiplied by itself three times.

$$7x^3 = 7 \cdot x \cdot x \cdot x$$

When all of the multiplications are written out instead of using the exponent, it is called the **expanded form**. Imagine if the exponent were greater, like $7x^{27}$ it would certainly take a lot of time, effort and space to write this in expanded form.

$$7x^{27} = 7 \cdot x$$

The exponent is truly valuable!

Let's look at how to write an expression out into expanded form.

$$(7x^3)(4x^5) = (7 \cdot x \cdot x \cdot x)(4 \cdot x \cdot x \cdot x \cdot x \cdot x)$$

The expression has been written in expanded form.

Next, use the commutative property of multiplication to change the order of the factors so that similar factors are next to each other.

$$\begin{aligned}(7x^3)(4x^5) &= (7 \cdot x \cdot x \cdot x)(4 \cdot x \cdot x \cdot x \cdot x \cdot x) \\ &= 7 \cdot 4 \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \quad \text{Parentheses disappear} \\ &= 28x^8 \quad \text{Multiply coefficients 7 and 4}\end{aligned}$$

The exponent 8 serves as a shortcut for the variables.

This question could also be done in another way. When multiplying expressions, multiply the coefficients and add the exponents of the same variables.

Let's look at an example.

Multiply the monomials:

$$(7x^3)(4x^5)$$

First, multiply the coefficients.

$$7 \times 4 = 28$$

Next, add the exponents.

$$3 + 5 = 8$$

Then, put these together.

$$(7x^3)(4x^5) = 28x^8$$

The answer is $28x^8$.

Examples

Example 1

Earlier, you were given a problem about Jenny and the free pass question. She couldn't answer the question which involved multiplying monomials. How can she do this multiplication?

Multiply the monomials:

$$(6y^3)(8y^5)(-1xy)$$

First, multiply the three coefficients.

$$6 \times 8 \times -1 = -48$$

Next, add the exponents. Only add the exponents of y since this is the only common variable.

$$3 + 5 + 1 = 9$$

Then, put these together.

$$(6y^3)(8y^5)(-1xy) = -48y^9x$$

The answer is $-48y^9x$.

Example 2

Multiply the following monomials:

$$(-6x^3)(8y^5)$$

First, multiply the coefficients.

$$-6 \times 8 = -48$$

Next, since the variables are not the same, you simply combine them with the coefficient.

$$(-6x^3)(8y^5) = -48x^3y^5$$

The answer is $-48x^3y^5$.

Example 3

Multiply the following monomials:

$$(6x^2)(4x^4)$$

First, multiply the coefficients.

$$6 \times 4 = 24$$

Next, add the exponents.

$$2 + 4 = 6$$

Then, put these together.

$$(6x^2)(4x^4) = 24x^6$$

The answer is $24x^6$.

Example 4

Multiply the monomials:

$$(2x^3)(4x^9)$$

First, multiply the coefficients.

$$2 \times 4 = 8$$

Next, add the exponents.

$$3 + 9 = 12$$

Then, put these together.

$$(2x^3)(4x^9) = 8x^{12}$$

The answer is $8x^{12}$.

Example 5

Multiply the monomials:

$$(6y^3)(8y^5)$$

First, multiply the coefficients.

$$6 \times 8 = 48$$

Next, add the exponents.

$$3 + 5 = 8$$

Then, put these together.

$$(6y^3)(8y^5) = 48x^8$$

The answer is $48x^8$.

Review

Multiply the following monomials.

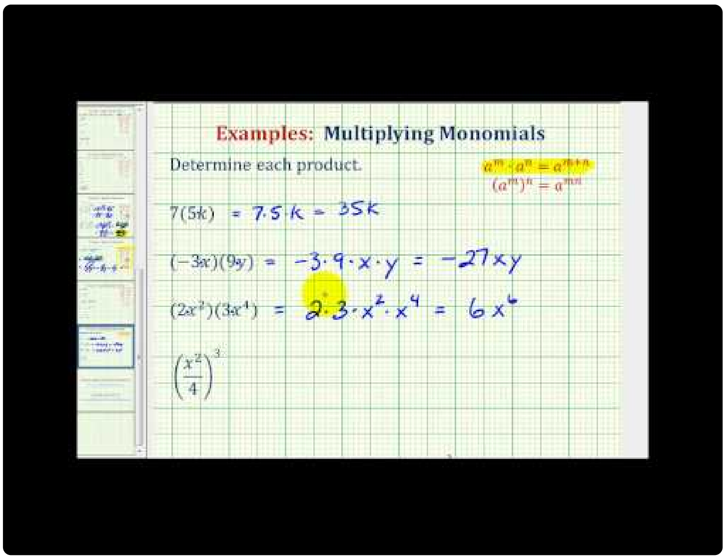
1. $(5x)(6xy)$

2. $(5x^2)(-6xy)$
3. $(-5x^2y)(2xy^2)$
4. $(-5x)(-9yz)$
5. $(18xy)(2xy^2z)$
6. $(2y^4)(6y^5)$
7. $(5x^3)(-5x^4y^3)$
8. $(-2y^5)(6y^3)(2y^2)$
9. $(5xy)(-2xy)(-x^2y^2)$
10. $(2ab)(6ab)(-4ab)$
11. $7x(6xy)$
12. $(15x^2)(-10x^3)$
13. $(5x)(6xy)(-9xy^5)$
14. $(-2x^3)(-4xy)(-5x^2y^4)$
15. $(-4abc)(-8a)(-4c)(d^2)$

Review (Answers)

To see the review answers, return to the Table of Contents and select ‘Other Versions’ or ‘Resources’.

Resources



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