Module 2: Properties of Exponents
Topic 1: Power of a Product

Introduction

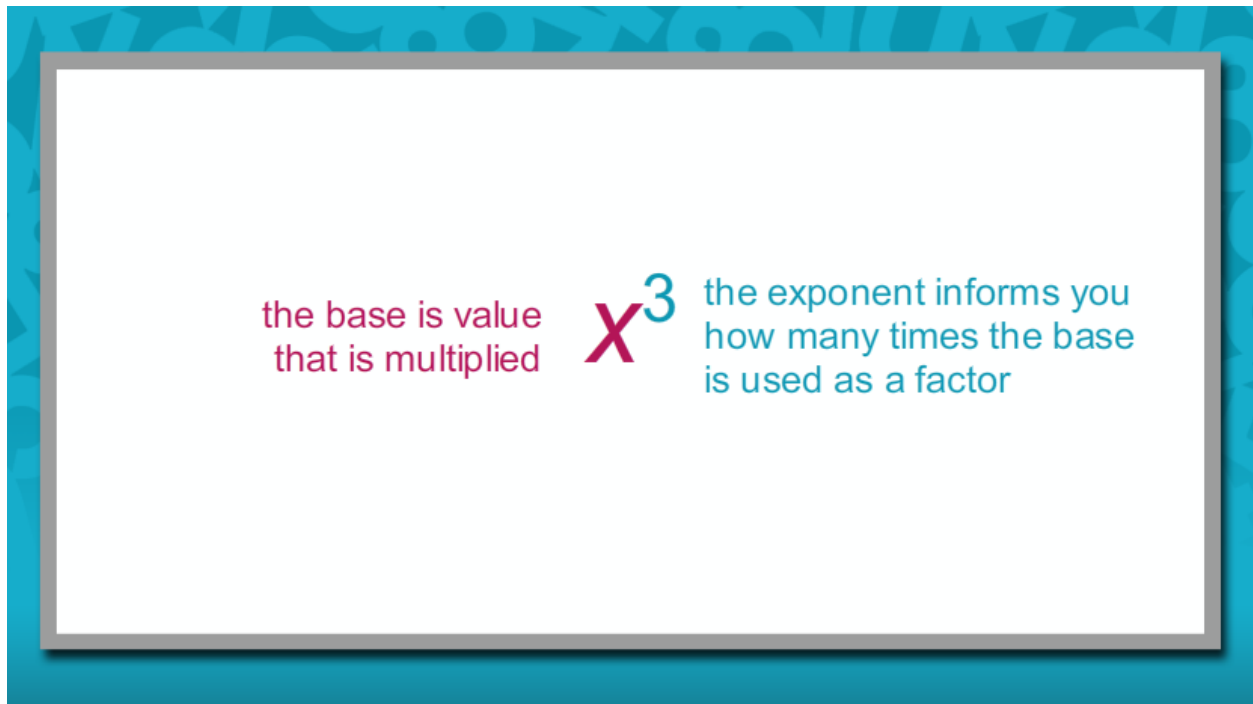Hi there! In your earlier math studies, you have simplified expressions that required you to raise a value to a given power. But what do you do when that value is product? How do you raise a product to a power? In this lesson, your prior knowledge of exponents will lead you to the answer to these questions.

Anticipatory Set

the base is value that is multiplied x^3 the exponent informs you how many times the base is used as a factor

You know that in an exponential expression, the base is the value that is multiplied; the exponent informs you how many times the base is used as a factor.
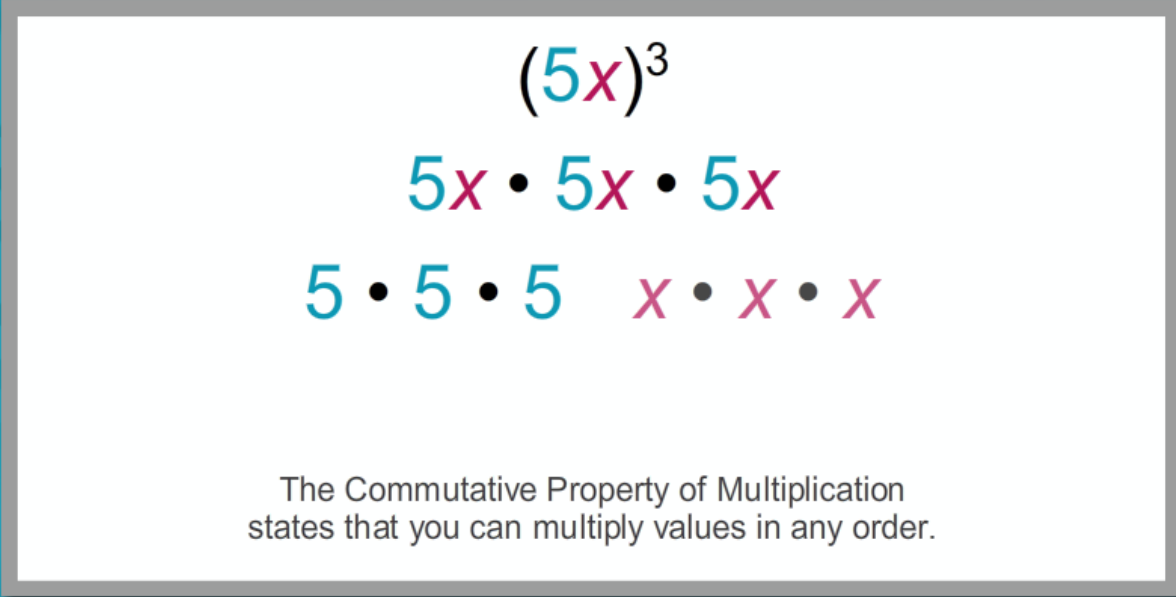
Anticipatory Set (continued)

$$(5x)^3$$
$$5x \cdot 5x \cdot 5x$$

Consider raising the product $5x$ to the third power. This expression is equivalent to $5x$ times $5x$ times $5x$.

Anticipatory Set (continued)

$$(5x)^3$$

$$5x \cdot 5x \cdot 5x$$

$$5 \cdot 5 \cdot 5 \quad x \cdot x \cdot x$$

The Commutative Property of Multiplication
states that you can multiply values in any order.

Now recall that the Commutative Property of Multiplication states that you can multiply values in any order. In this example, change the order of multiplication so that you find the product of the fives first, and then the product of the x's.

Anticipatory Set (continued)

$$(5x)^3$$

$$5x \cdot 5x \cdot 5x$$

$$5 \cdot 5 \cdot 5 \cdot x \cdot x \cdot x$$

$$(5 \cdot 5 \cdot 5) \cdot (x \cdot x \cdot x)$$

$$5^3 \cdot x^3$$

You can simplify this expression by considering it as the product of five to the third power and x to the third power.

Anticipatory Set (continued)

Power of a Product Property

When raising a product to a power, you must raise each factor to the indicated power and then multiply.

$$(am)^r = a^r \cdot m^r$$

This expression shows the pattern that appears when you raise a product to a power; you must raise each factor to the indicated power, and then multiply. This is known as the Power of a Product Property.

$$(am)^r = a^r \cdot m^r$$

Power of a Product

Click the examples below to learn more.

- Example One
- Example Two
- Self-Check

Example 1

EXAMPLE 1

Simplify the expression: $(4cd)^2$

$(4cd)^2$

Simplify the expression: $(4cd)^2$

In this example, you are asked to raise the product $4cd$ to the second power. According to the Power of a Product Property, you must raise each factor to the second power, and then multiply.

Example 1 (continued)

EXAMPLE 1

Simplify the expression: $(4cd)^2$

$$(4cd)^2 = 4^2 \cdot c^2 \cdot d^2$$

So, the product $4cd$ raised to the second power is equivalent to 4^2 times c^2 times d^2. Now continue to simplify the expression.

Example 1 (continued)

EXAMPLE 1

Simplify the expression: $(4cd)^2$

$$(4cd)^2 = 4^2 \cdot c^2 \cdot d^2$$

$$= 16 \cdot c^2 \cdot d^2$$

$$= 16c^2d^2$$

4^2 is 16.

Now, simplify the product.

Example 1 (continued)

EXAMPLE 1

Simplify the expression: $(4cd)^2$

$$(4cd)^2 = 4^2 \cdot c^2 \cdot d^2$$

$$= 16 \cdot c^2 \cdot d^2$$

$$= \boxed{16c^2d^2}$$

Your work is complete. The final answer is $16c^2d^2$.

Example 2

Simplify the expression: $(5x^2y^6)^3$

In this example, you must raise the product $5x^2y^6$ to the third power. According to the Power of a Product Property, you must raise each factor to the third power.

Therefore, $(5x^2y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$.

A) True

B) False

Is the expression above true or false? Please click on the correct answer.

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2y^6)^3$

$$(5x^2y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$$

Is the expression above true or false?

True

According to the Power of a Product Property, you must raise each factor to the third power. So the expression above holds true.

Next

Feedback: According to the Power of a Product Property, you must raise each factor to the third power.

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2y^6)^3$

$$(5x^2y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$$

Enter the correct answer below and click submit.

$$5^3 = \boxed{}$$

Submit

Now evaluate 5^3. You may choose to use the calculator or paper and pencil.

$5^3 = ?$

Enter the correct answer below and click submit.

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2 y^6)^3$

$$(5x^2 y^6)^3 \;=\; 5^3 \cdot (x^2)^3 \cdot (y^6)^3$$

$$= \; 125$$

5 cubed is equal to 125.

$$5^3 \;=\; 125$$

Next

Feedback: $5^3 = 125.$

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2 y^6)^3$

$(5x^2 y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$

$= 125$

Which exponent correctly completes the expression below?

| 5 | 6 | 8 |

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

Now it's time to raise x^2 to the third power. Remember to raise a power to a power, you must multiply the exponents.

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

A) 5

B) 6

C) 8

Which exponent correctly completes the expression below?

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2 y^6)^3$

$(5x^2 y^6)^3 \quad = \quad 5^3 \cdot (x^2)^3 \cdot (y^6)^3$

$= \quad 125 \cdot x^6$

When you multiply the exponents of $(x^2)^3$ you get x^6.

6

$(x^2)^3 = x^{2 \cdot 3} = x^6$

Next

Feedback: $(x^2)^3 = x^{2 \cdot 3} = x^6$

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2 y^6)^3$

$(5x^2 y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$

$= 125 \cdot x^6$

Which exponent correctly completes the expression below?

| 3 | 9 | 18 |

$(y^6)^3 = y^?$

Now, raise y^6 to the third power.

$(y^6)^3 = y^?$

A) 3

B) 9

C) 18

Which exponent correctly completed the expression below?

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2 y^6)^3$

$$(5x^2 y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$$
$$= 125 \cdot x^6 \cdot y^{18}$$

When you multiply the exponents of $(y^6)^3$ you get y^{18}.

18

$$(y^6)^3 = y^{6 \cdot 3} = y^{18}$$

Next

Feedback: $(y^6)^3 = y^{6 \cdot 3} = y^{18}$

Example 2 (continued)

EXAMPLE 2

Simplify the expression: $(5x^2y^6)^3$

$$(5x^2y^6)^3 = 5^3 \cdot (x^2)^3 \cdot (y^6)^3$$
$$= 125 \cdot x^6 \cdot y^{18}$$
$$= \boxed{125x^6y^{18}}$$
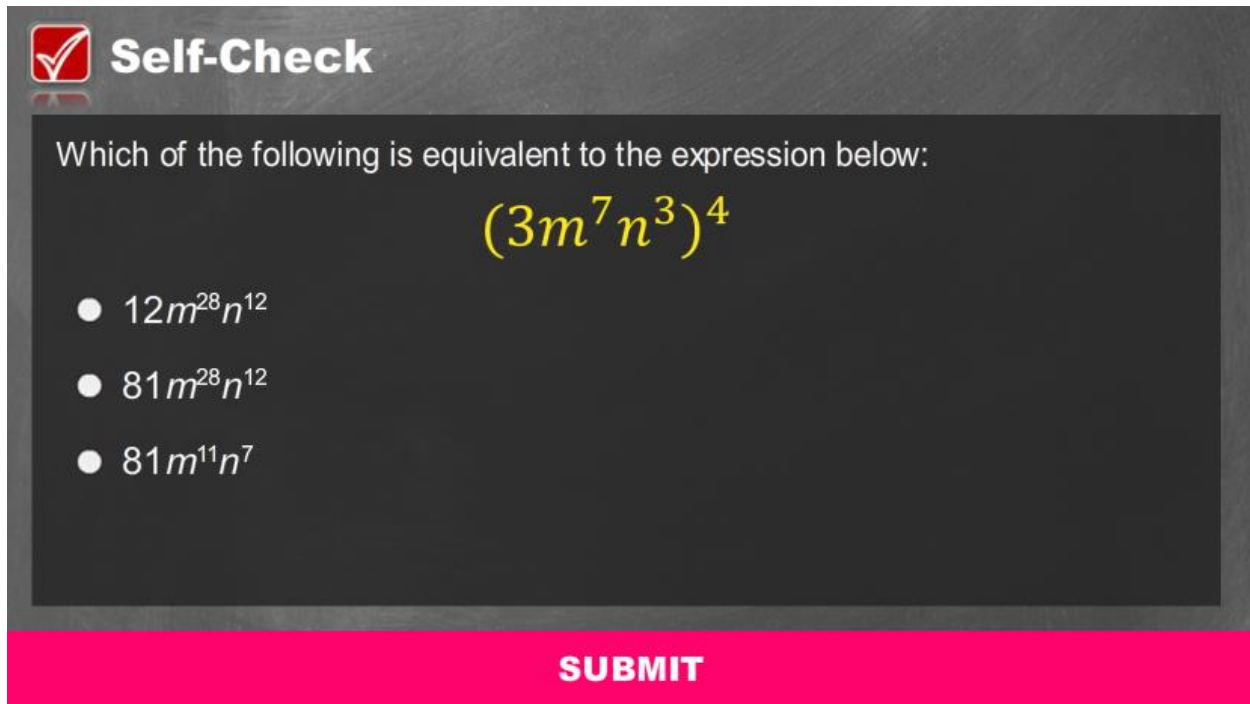
Menu

Now simplify. Your work is complete. The final answer is $125x^6y^{18}$.

Self-Check

Self-Check

Which of the following is equivalent to the expression below:

$$(3m^7 n^3)^4$$

- $12m^{28}n^{12}$
- $81m^{28}n^{12}$
- $81m^{11}n^7$

SUBMIT

Solve the problem in the image above to check your understanding of the content.

Self-Check: Answer

Correct

That's correct! Begin by applying the Power of a Product Property.

$$(3m^7n^3)^4 = 3^4 \cdot (m^7)^4 \cdot (n^3)^4$$
$$= 81 \cdot m^{7 \cdot 4} \cdot n^{3 \cdot 4}$$

Then evaluate the powers.

$$= 81 \cdot m^{28} \cdot n^{12}$$

Simplify.

$$= \boxed{81m^{28}n^{12}}$$

Continue

SUBMIT

For your reference, the image above shows the correct solution to the self-check problem.

Conclusion

Congratulations! You have reached the conclusion of this lesson in Algebra I. In this lesson, you used your knowledge of exponents to discover a rule that allows you to easily determine the power of a product.