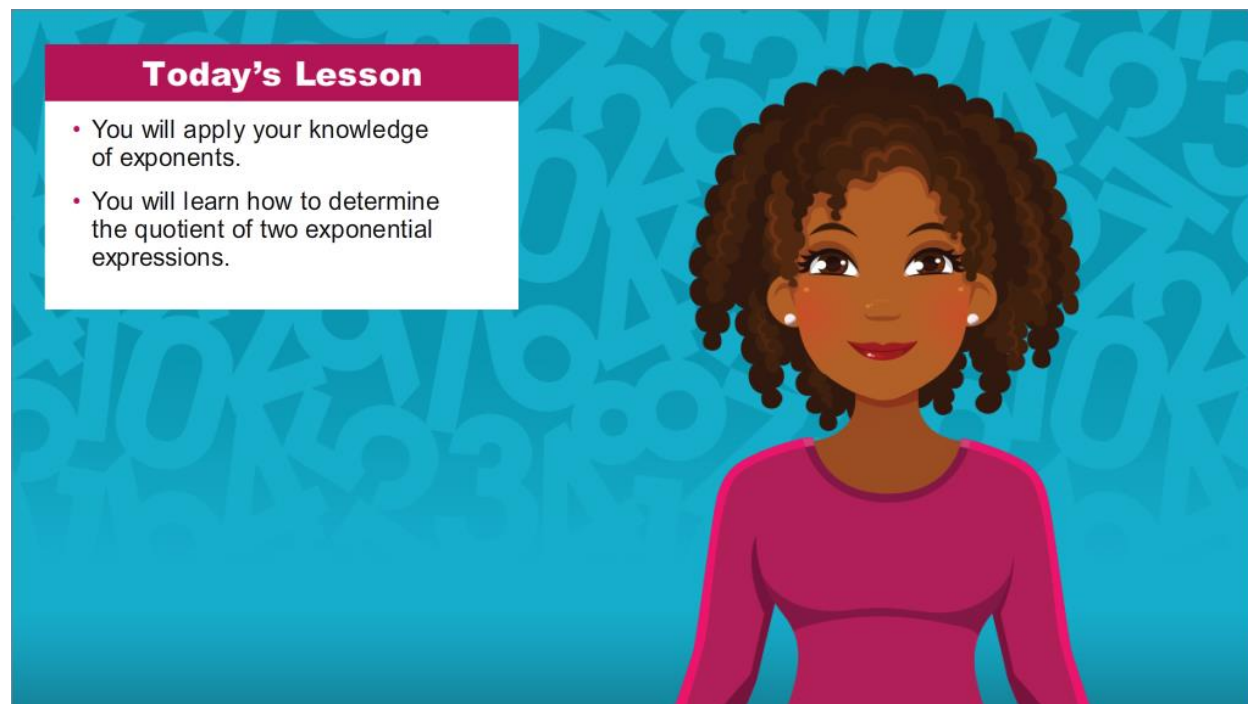


## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Introduction



**Today's Lesson**

- You will apply your knowledge of exponents.
- You will learn how to determine the quotient of two exponential expressions.

Hi there! I'm so glad to have you here for this lesson in Algebra I. In this lesson, you will apply your knowledge of exponents to discover a rule that allows you to easily determine the quotient of two exponential expressions.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Quotient of Powers Property

$$\frac{x^5}{x^3} = \frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x}$$

Consider the quotient of  $x^5$  and  $x^3$ . Begin by expanding the numerator:  $x^5$  represents the product of 5  $x$ 's. The denominator,  $x^3$ , represents the product of 3  $x$ 's.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Quotient of Powers Property (continued)

$$\begin{aligned}\frac{x^5}{x^3} &= \frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x} \\ &= \frac{x}{x} \cdot \frac{x}{x} \cdot \frac{x}{x} \cdot x \cdot x\end{aligned}$$

Now you have an expression that represents the quotient of products. Instead, represent this expression as the product of quotients.

Rewrite the expression as:  $x$  over  $x$ , times  $x$  over  $x$ , times  $x$  over  $x$ , and because there are no more  $x$ 's left in the denominator, you will multiply these quotients times the final  $x$  factors.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Quotient of Powers Property (continued)

$$\begin{aligned}\frac{x^5}{x^3} &= \frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x} \\ &= \frac{x}{x} \cdot \frac{x}{x} \cdot \frac{x}{x} \cdot x \cdot x \\ &= 1 \cdot 1 \cdot 1 \cdot x \cdot x\end{aligned}$$

Now begin simplifying the expression. Recall that any value divided by itself is equal to 1. So, the quotients of  $x$  and  $x$  can each be simplified to 1, and you still are still multiplying these expressions by the remaining  $x$  factors.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Quotient of Powers Property (continued)

$$\begin{aligned}\frac{x^5}{x^3} &= \frac{x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x} \\ &= \frac{x}{x} \cdot \frac{x}{x} \cdot \frac{x}{x} \cdot x \cdot x \\ &= 1 \cdot 1 \cdot 1 \cdot x \cdot x \\ &= x^2 = x^{5-3}\end{aligned}$$

1 times 1 times 1 times  $x$  times  $x$  can be simplified to  $x^2$ . The exponent in the result is the difference of the exponents in the original expression.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Quotient of Powers Property (continued)

### Quotient of Powers Property

When dividing exponential expressions that have the same base, you must subtract the exponents.

$$\text{If } a \neq 0, \text{ then } \frac{a^r}{a^s} = a^{r-s}$$

This example shows the pattern that appears when dividing exponential expressions that have the same base; you must subtract the exponents. This is known as the Quotient of Powers Property.

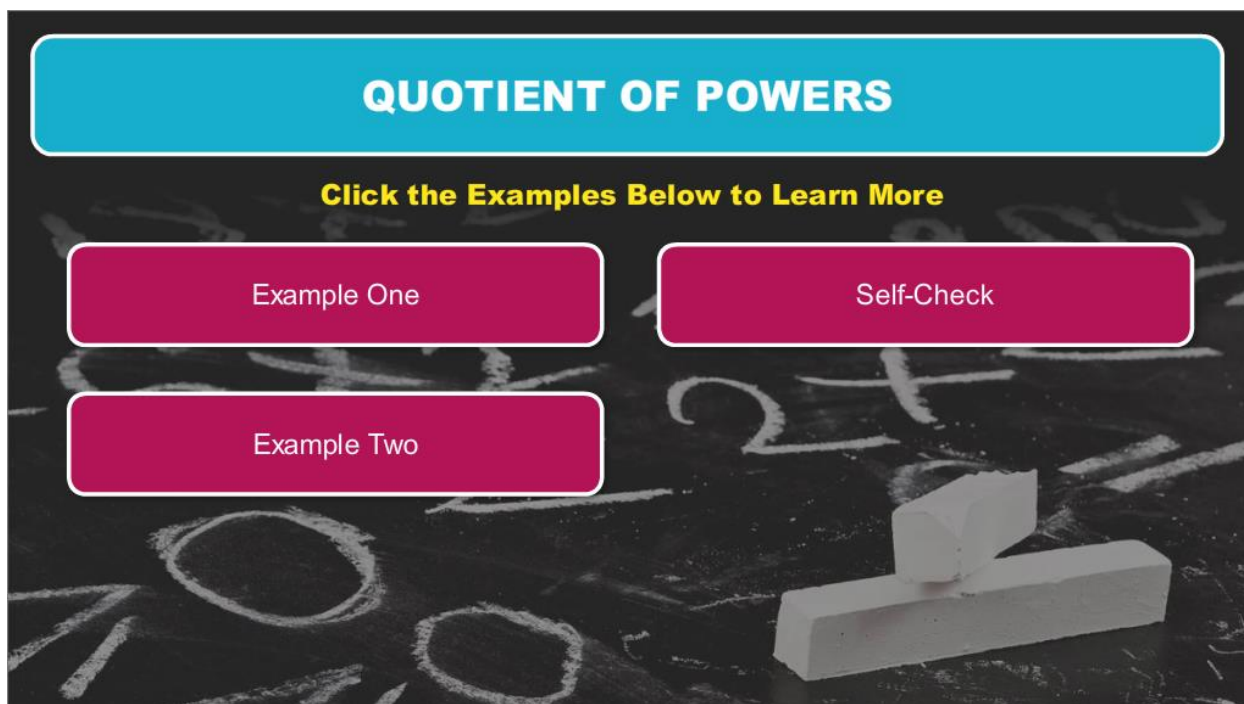
Quotient of Powers Property

$$\text{If } a \neq 0, \text{ then } \frac{a^r}{a^s} = a^{r-s}.$$

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Quotient of Powers

An interactive graphic with a dark background featuring faint chalkboard-style math symbols. At the top is a blue rounded rectangle with the text "QUOTIENT OF POWERS" in white. Below it is a yellow text prompt: "Click the Examples Below to Learn More". There are three pink rounded rectangular buttons: "Example One" (top left), "Self-Check" (top right), and "Example Two" (bottom left). In the bottom right corner, there is a photograph of a white rectangular block with a smaller white cube resting on top of it.

**QUOTIENT OF POWERS**

Click the Examples Below to Learn More

Example One

Self-Check

Example Two

Click the examples below to learn more.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Example 1

#### EXAMPLE 1

Simplify the expression:  $\frac{b^{14}c^7}{b^{10}c^5}$

$$\frac{b^{14}c^7}{b^{10}c^5} = \frac{b^{14}}{b^{10}} \cdot \frac{c^7}{c^5}$$

Simplify the expression:  $\frac{b^{14}c^7}{b^{10}c^5}$

In this example, begin by representing the expression as the product of two quotients:  $\frac{b^{14}}{b^{10}}$   
times  $\frac{c^7}{c^5}$ .



## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

Example 1 (continued)

#### EXAMPLE 1

Simplify the expression:  $\frac{b^{14}c^7}{b^{10}c^5}$

$$\begin{aligned}\frac{b^{14}c^7}{b^{10}c^5} &= \frac{b^{14}}{b^{10}} \cdot \frac{c^7}{c^5} \\ &= b^{14-10} \cdot c^{7-5} \\ &= b^4\end{aligned}$$

Now apply the Quotient of Powers Property to simplify each quotient. To do this, you must subtract the exponents.

In the first quotient,  $14 - 10$  is 4, so this expression simplifies to  $b^4$ .

**Module 2: Properties of Exponents**  
**Topic 2: Quotient of Powers**

Example 1 (continued)

**EXAMPLE 1**

Simplify the expression:  $\frac{b^{14}c^7}{b^{10}c^5}$

$$\begin{aligned}\frac{b^{14}c^7}{b^{10}c^5} &= \frac{b^{14}}{b^{10}} \cdot \frac{c^7}{c^5} \\ &= b^{14-10} \cdot c^{7-5} \\ &= b^4 \cdot c^2\end{aligned}$$

In the second quotient,  $7 - 5$  is 2., so this expression simplifies to  $c^2$ .

**Module 2: Properties of Exponents**  
**Topic 2: Quotient of Powers**

Example 1 (continued)

**EXAMPLE 1**

Simplify the expression:  $\frac{b^{14}c^7}{b^{10}c^5}$

$$\begin{aligned}\frac{b^{14}c^7}{b^{10}c^5} &= \frac{b^{14}}{b^{10}} \cdot \frac{c^7}{c^5} \\ &= b^{14-10} \cdot c^{7-5} \\ &= b^4 \cdot c^2 \\ &= \boxed{b^4c^2}\end{aligned}$$

Now simplify the product. Your work is complete. The final answer is  $b^4c^2$ .

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Example 2

**EXAMPLE 2**

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\frac{50a^9b^5}{5a^7b^2} = \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2}$$

Enter the correct answer below and click submit.

$$\frac{50}{5} = \text{[ ]}$$

**Submit**

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

In this example, begin by representing the expression as the product of quotients:  $\frac{50}{5}$  times  $\frac{a^9}{a^7}$  times  $\frac{b^5}{b^2}$ . Now simplify.

$$\frac{50}{5} = ?$$

Enter the correct answer below and click submit.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

Example 2 (continued)

#### EXAMPLE 2

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\begin{aligned}\frac{50a^9b^5}{5a^7b^2} &= \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2} \\ &= 10\end{aligned}$$

50 divided by 5 is equal to 10.

$$\frac{50}{5} = 10$$

Next

Feedback:  $\frac{50}{5} = 10$

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

Example 2 (continued)

#### EXAMPLE 2

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\frac{50a^9b^5}{5a^7b^2} = \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2}$$
$$= 10$$

Enter the correct exponent below and click submit.

$$\frac{a^9}{a^7} = a^{\boxed{\phantom{000}}}$$

Submit

In order to divide  $a^9$  and  $a^7$ , you will need to subtract the exponents.

$$\frac{a^9}{a^7} = a^?$$

Enter the correct exponent below and click submit.

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

Example 2 (continued)

#### EXAMPLE 2

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\begin{aligned}\frac{50a^9b^5}{5a^7b^2} &= \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2} \\ &= 10 \cdot a^2\end{aligned}$$

$a^9$  divided by  $a^7$  is equal to  $a^2$ .

$$\frac{a^9}{a^7} = a^{9-7} = a^2$$

Next

Feedback:  $\frac{a^9}{a^7} = a^{9-7} = a^2$

**Module 2: Properties of Exponents**  
**Topic 2: Quotient of Powers**

Example 2 (continued)

**EXAMPLE 2**

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\frac{50a^9b^5}{5a^7b^2} = \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2}$$
$$= 10 \cdot a^2$$

Enter the correct exponent below and click submit.

$$\frac{b^5}{b^2} = b^{\boxed{\phantom{000}}}$$

Submit

In order to divide  $b^5$  and  $b^2$ , you will need to subtract the exponents.

$$\frac{b^5}{b^2} = b^?$$

Enter the correct exponent below and click submit.



## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

Example 2 (continued)

#### EXAMPLE 2

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\begin{aligned}\frac{50a^9b^5}{5a^7b^2} &= \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2} \\ &= 10 \cdot a^2 \cdot b^3\end{aligned}$$

$b^5$  divided by  $b^2$  is equal to  $b^3$ .

$$\frac{b^5}{b^2} = b^{5-2} = b^3$$

Next

Feedback:  $\frac{b^5}{b^2} = b^{5-2} = b^3$

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

Example 2 (continued)

#### EXAMPLE 2

Simplify the expression:  $\frac{50a^9b^5}{5a^7b^2}$

$$\begin{aligned}\frac{50a^9b^5}{5a^7b^2} &= \frac{50}{5} \cdot \frac{a^9}{a^7} \cdot \frac{b^5}{b^2} \\ &= 10 \cdot a^2 \cdot b^3 \\ &= \boxed{10a^2b^3}\end{aligned}$$

Menu

Now simplify the product. Your work is complete. The final answer is  $10a^2b^3$ .

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Self-Check



#### Self-Check

Which of the following expressions is equivalent to  $\frac{36x^8y^{10}}{9x^2y^5}$

- $4x^6y^5$
- $25x^6y^5$
- $4x^4y^2$

**SUBMIT**

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

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Self-Check: Answer

**Correct**

That's correct! To begin, consider the expression as a product of quotients.

$$\frac{36x^8y^{10}}{9x^2y^5} = \frac{36}{9} \cdot \frac{x^8}{x^2} \cdot \frac{y^{10}}{y^5}$$

Divide the numerical values. Apply the Quotient of Powers Property to simplify the exponential expressions.

$$= 4 \cdot x^{8-2} \cdot y^{10-5}$$
$$= 4 \cdot x^6 \cdot y^5$$

Simplify the product.

$$= 4x^6y^5$$

Continue

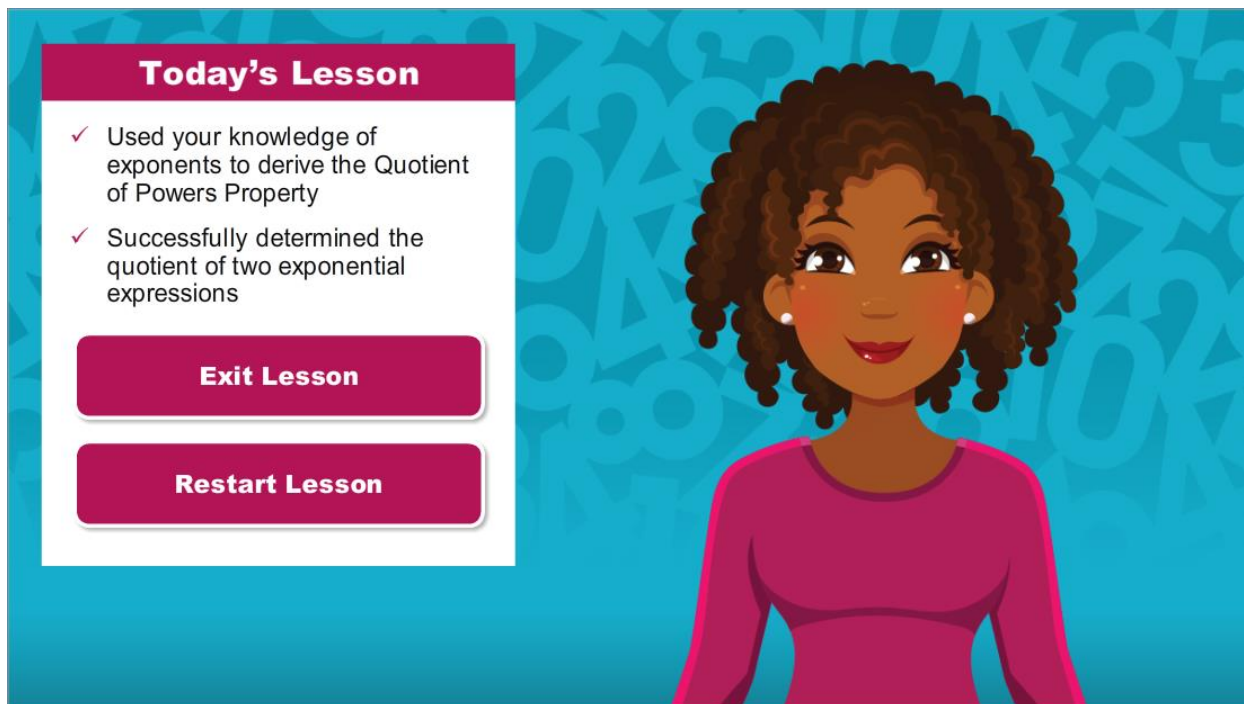
**SUBMIT**

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

## Module 2: Properties of Exponents

### Topic 2: Quotient of Powers

#### Conclusion



The image shows a digital interface for a lesson conclusion. On the right side, there is a cartoon illustration of a young woman with dark, curly hair, wearing a pink long-sleeved shirt, smiling. The background is a light blue with a pattern of faint mathematical symbols like pi, infinity, and numbers. On the left side, there is a white rectangular box with a pink header that says "Today's Lesson". Inside this box, there are two bullet points with checkmarks, two pink buttons labeled "Exit Lesson" and "Restart Lesson", and a pink footer area.

**Today's Lesson**

- ✓ Used your knowledge of exponents to derive the Quotient of Powers Property
- ✓ Successfully determined the quotient of two exponential expressions

**Exit Lesson**

**Restart Lesson**

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 allowed you to easily determine the quotient of two exponential expressions.