

Module 2: Properties of Exponents

Topic 2: Power of a Quotient

Introduction



Today's Lesson

- You will apply your knowledge of exponents.
- You will learn how to raise a quotient to a power.

Hello and welcome! You are most likely familiar with what it means to raise a value to a power, but what do you do when that value is a quotient? How do you raise a quotient to a power? In this lesson, you will use your knowledge of exponents to guide you to the answer to these questions.

Module 2: Properties of Exponents

Topic 2: Power of a Quotient

Power of a Quotient Property

the base is value
that is multiplied

\times^4

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 power informs you how many times the base is used as a factor.

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Topic 2: Power of a Quotient

Power of a Quotient Property (continued)

$$\left(\frac{x}{y}\right)^4 = \frac{x}{y} \cdot \frac{x}{y} \cdot \frac{x}{y} \cdot \frac{x}{y} = \frac{x^4}{y^4}$$

Consider raising the quotient of x and y to the fourth power. This expression is equivalent to $\frac{x}{y}$ times $\frac{x}{y}$ times $\frac{x}{y}$ times $\frac{x}{y}$; or more simply x^4 over y^4 .

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Power of a Quotient Property (continued)

Power of a Quotient Property

When raising a quotient to a power, you must raise the numerator to the indicated power, and raise the denominator to the indicated power.

$$\text{If } m \neq 0, \text{ then } \left(\frac{a}{m}\right)^r = \frac{a^r}{m^r}$$

This example shows the pattern that appears when you raise a quotient to a power; you must raise the numerator to the indicated power, and raise the denominator to the indicated power. This is known as the Power of a Quotient Property.

Power of a Quotient Property

$$\text{If } m \neq 0, \text{ then } \left(\frac{a}{m}\right)^r = \frac{a^r}{m^r}.$$

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Power of a Quotient

POWER OF A QUOTIENT

Click the Examples Below to Learn More

Example One

Self-Check

Example Two

The graphic features a dark background with faint chalkboard-style numbers and symbols. In the bottom right corner, there is a 3D rendering of a white rectangular block with a smaller white cube-like shape on top of it.

Click the examples below the learn more.

Module 2: Properties of Exponents

Topic 2: Power of a Quotient

Example 1

EXAMPLE 1

Simplify the expression: $\left(\frac{c}{4}\right)^3$

$$\left(\frac{c}{4}\right)^3$$

Simplify the expression: $\left(\frac{c}{4}\right)^3$

In this example, you are asked to raise the quotient of c and 4 to the third power. According to the Power of a Quotient Property, you must raise both the numerator denominator to the third power.

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Example 1 (continued)

EXAMPLE 1

Simplify the expression: $\left(\frac{c}{4}\right)^3$

$$\begin{aligned}\left(\frac{c}{4}\right)^3 &= \frac{c^3}{4^3} \\ &= \frac{c^3}{64}\end{aligned}$$

So the quotient of c and 4 raised to the third power is equivalent to c^3 over 4^3 . Now simplify the denominator. 4^3 is 64. Your work is complete.

The final answer is $\frac{c^3}{64}$.

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Example 2

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\left(\frac{6x^7y^2}{5v^4}\right)^2 = \frac{(6x^7y^2)^2}{(5v^4)^2}$$

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

According to the Power of a Quotient Property, to simplify this expression you must raise both the numerator and denominator to the second power.

$$\left(\frac{6x^7y^2}{5v^4}\right)^2 = \frac{(6x^7y^2)^2}{(5v^4)^2}$$

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\left(\frac{6x^7y^2}{5v^4}\right)^2 = \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2}$$

Is the expression above true or false?

True

False

Please click on the correct answer.

In order to simplify the expressions in the numerator and denominator, you must apply the Power of a Product Property, which in this case means raising each factor to the second power.

Therefore, $\frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2}$

Is the expression above true or false?

A) True

B) False

Please click on the correct answer.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\left(\frac{6x^7y^2}{5v^4}\right)^2 = \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2}$$

Is the expression above true or false?

True

According to the Power of a Product Property, you must raise each factor in the numerator and denominator to the second power. So the expression above holds true.

Next

Feedback: According to the Power of a Product Property, you must raise each factor in the numerator and denominator to the second power.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\left(\frac{6x^7y^2}{5v^4}\right)^2 = \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2}$$

Enter the correct answer below and click submit.

$$6^2 = \input{text}$$

Submit

Now simplify the expression in the numerator.

$$6^2 = ?$$

Enter the correct answer below and click submit.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \underline{\underline{36}}\end{aligned}$$

6 squared is equal to 36.

$$6^2 = 36$$

Feedback: $6^2 = 36$.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \frac{36}{}\end{aligned}$$

Which exponent correctly completes the following expression?

$$(x^7)^2 = x^?$$

5

14

49

Now it's time to raise x^7 to the second power. Remember, to raise a power to a power, you must multiply the exponents.

$$(x^7)^2 = x^?$$

A) 5

B) 14

C) 49

Which exponent correctly completes the following expression?

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \underline{36 \cdot x^{14}}\end{aligned}$$

x^7 squared is equal to x^{14} .

$$(x^7)^2 = x^{7 \cdot 2} = x^{14}$$

14

Next

Feedback: $(x^7)^2 = x^{7 \cdot 2} = x^{14}$

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \underline{36 \cdot x^{14}}\end{aligned}$$

Which exponent correctly completes the following expression?

$$(y^2)^2 = y^?$$

0

4

6

Now, raise y^2 to the second power.

$$(y^2)^2 = y^?$$

- A) 0
- B) 4**
- C) 6

Which exponent correctly completes the following expression?

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \underline{36 \cdot x^{14} \cdot y^4}\end{aligned}$$

y^2 squared is equal to y^4 .

$$(y^2)^2 = y^{2 \cdot 2} = y^4$$

4

Next

Feedback: $(y^2)^2 = y^{2 \cdot 2} = y^4$

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \frac{36 \cdot x^{14} \cdot y^4}{5^2 \cdot v^8}\end{aligned}$$

Enter the correct answer below and click submit.

$5^2 =$

Submit

Now simplify the expression in the denominator.

$5^2 = ?$

Enter the correct answer below and click submit.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \frac{36 \cdot x^{14} \cdot y^4}{25}\end{aligned}$$

5 squared is equal to 25.

$$5^2 = 25$$

Next

Feedback: $5^2 = 25$.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \frac{36 \cdot x^{14} \cdot y^4}{25}\end{aligned}$$

Which exponent correctly completes the following expression?

$$(v^4)^2 = v^?$$

2

6

8

Now it's time to raise v^4 to the second power. Remember, to raise a power to a power, you must multiply the exponents.

$$(v^4)^2 = v^?$$

- A) 2
- B) 6
- C) 8**

Which exponent correctly completes the following expression?

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \frac{36 \cdot x^{14} \cdot y^4}{25 \cdot v^8}\end{aligned}$$

v^4 squared is equal to v^8 .

$$(v^4)^2 = v^{4 \cdot 2} = v^8$$

8

Next

Feedback: $(v^4)^2 = v^{4 \cdot 2} = v^8$.

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Example 2 (continued)

EXAMPLE 2

Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

$$\begin{aligned}\left(\frac{6x^7y^2}{5v^4}\right)^2 &= \frac{(6x^7y^2)^2}{(5v^4)^2} = \frac{6^2 \cdot (x^7)^2 \cdot (y^2)^2}{5^2 \cdot (v^4)^2} \\ &= \frac{36 \cdot x^{14} \cdot y^4}{25 \cdot v^8} \\ &= \frac{36x^{14}y^4}{25v^8}\end{aligned}$$

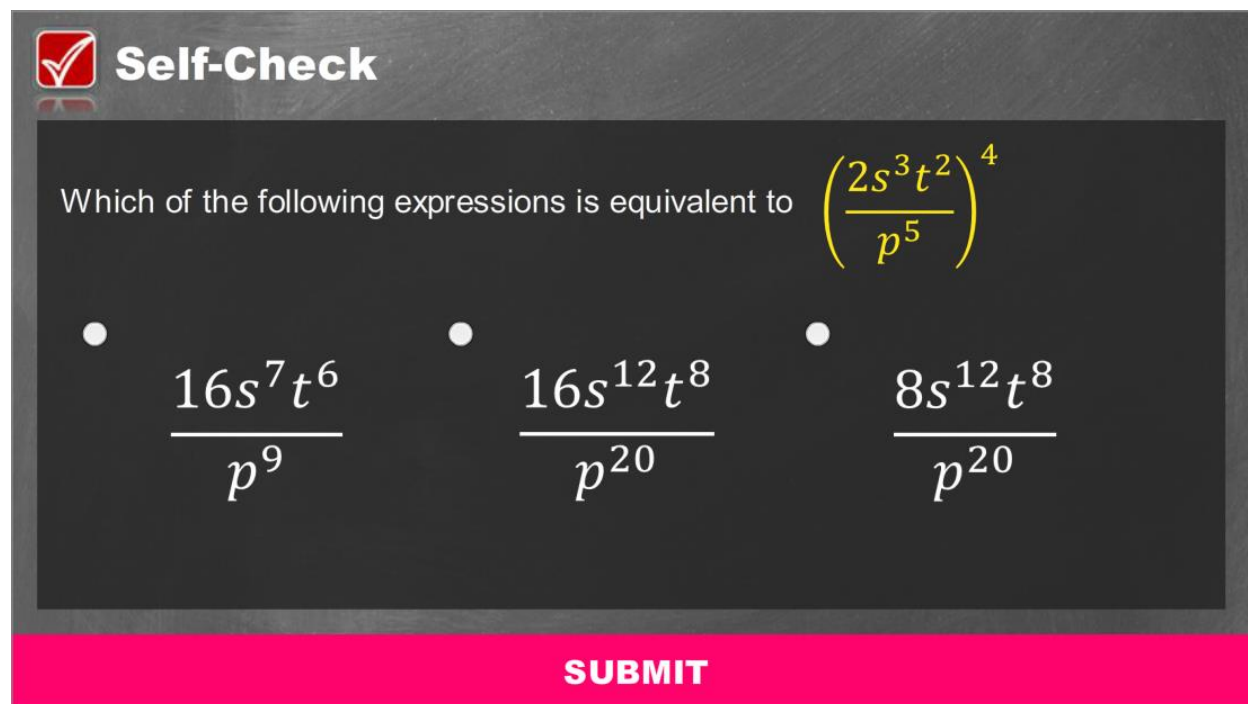
Menu

Now simplify. Your work is complete.

The final answer is $\frac{36x^{14}y^4}{25v^8}$.

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Self-Check



Self-Check

Which of the following expressions is equivalent to $\left(\frac{2s^3t^2}{p^5}\right)^4$

- $\frac{16s^7t^6}{p^9}$
- $\frac{16s^{12}t^8}{p^{20}}$
- $\frac{8s^{12}t^8}{p^{20}}$

SUBMIT

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

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Self-Check: Answer

Correct

That's correct! Use the following process to simplify the expression. Begin by applying the Power of a Quotient Property.

$$\left(\frac{2s^3t^2}{p^5}\right)^4 = \frac{(2s^3t^2)^4}{(p^5)^4}$$

Then apply the Power of a Product Property.

$$\frac{2^4 \cdot (s^3)^4 \cdot (t^2)^4}{(p^5)^4}$$

Now apply the Power of a Power Property.

$$\frac{16 \cdot s^{12} \cdot t^8}{p^{20}}$$

Simplify the products in the numerator and denominator.

$$\frac{16s^{12}t^8}{p^{20}}$$

Continue

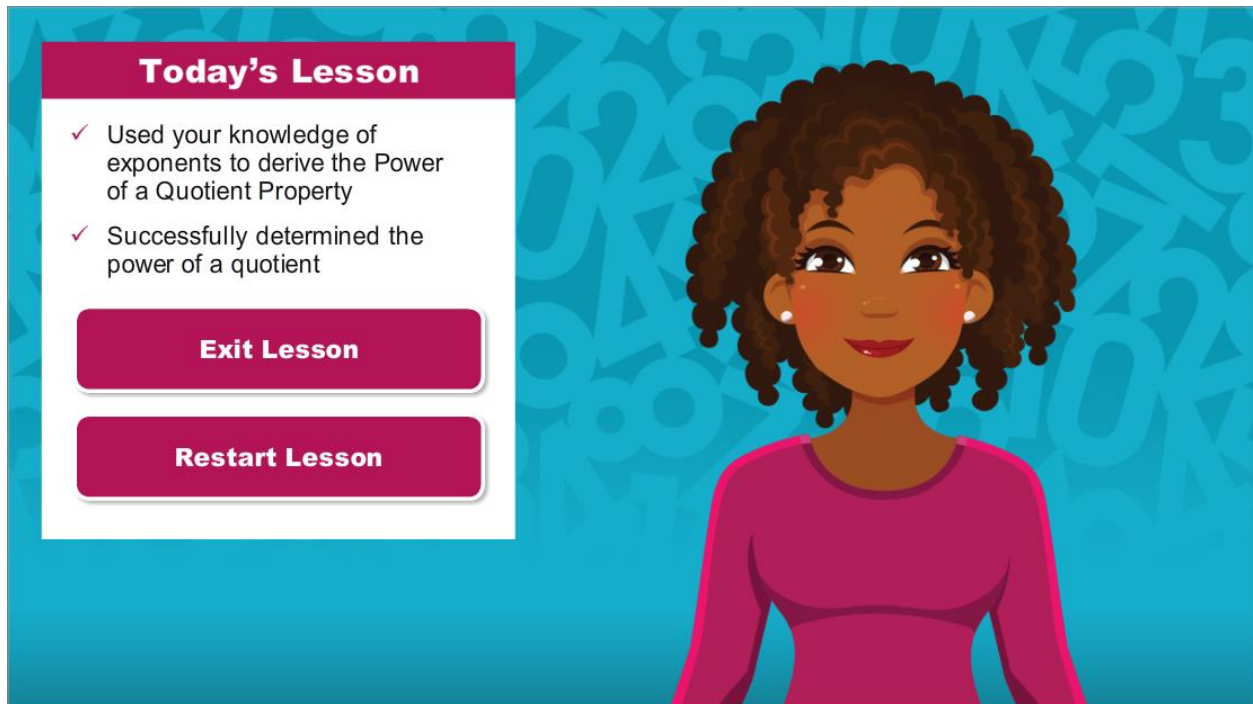
SUBMIT

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

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Conclusion



Today's Lesson

- ✓ Used your knowledge of exponents to derive the Power of a Quotient Property
- ✓ Successfully determined the power of a quotient

Exit Lesson

Restart Lesson

Congratulations! In this lesson, you used your knowledge of exponents to discover a rule that allows you to easily determine the power of a quotient.