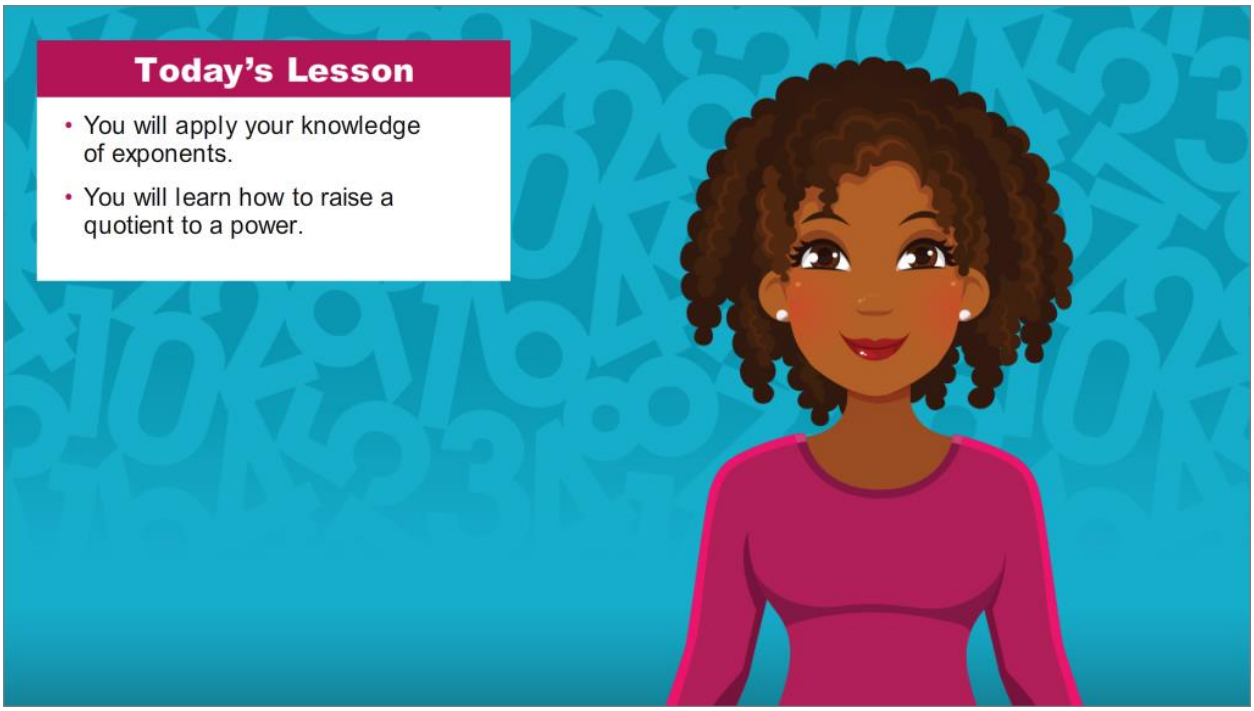
Module 2: Properties of Exponents
Topic 2: Power of a Quotient

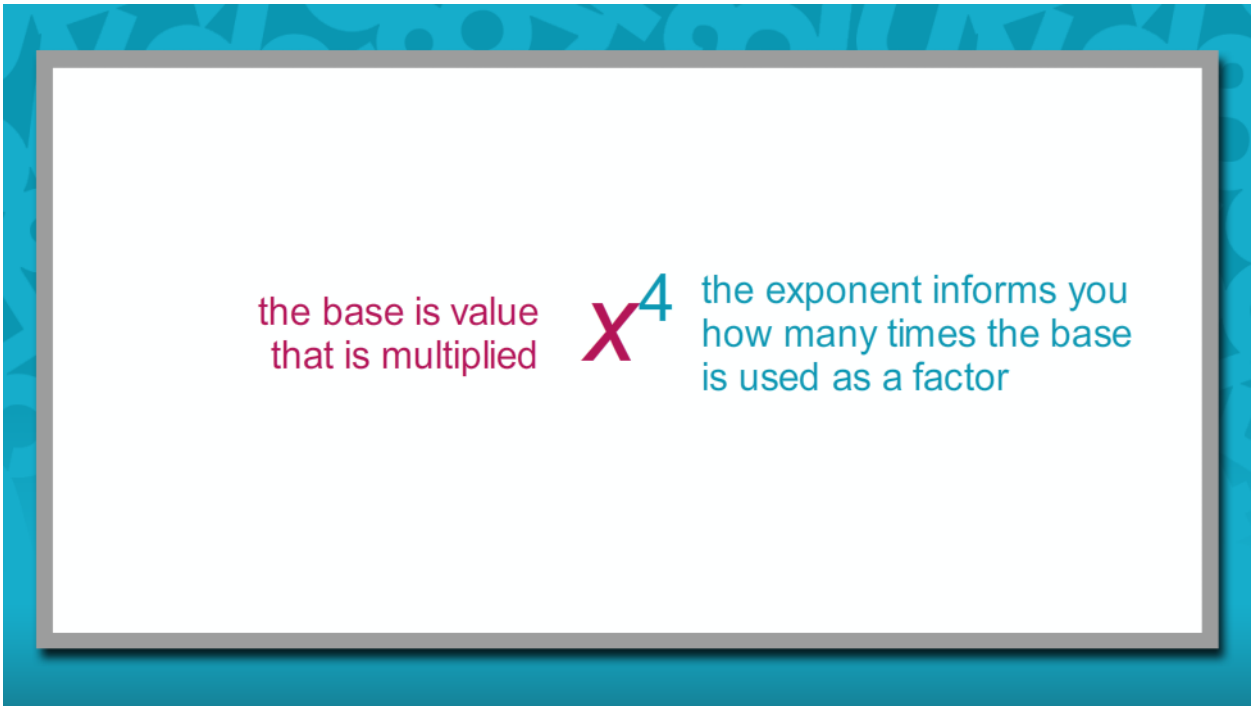
Introduction



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



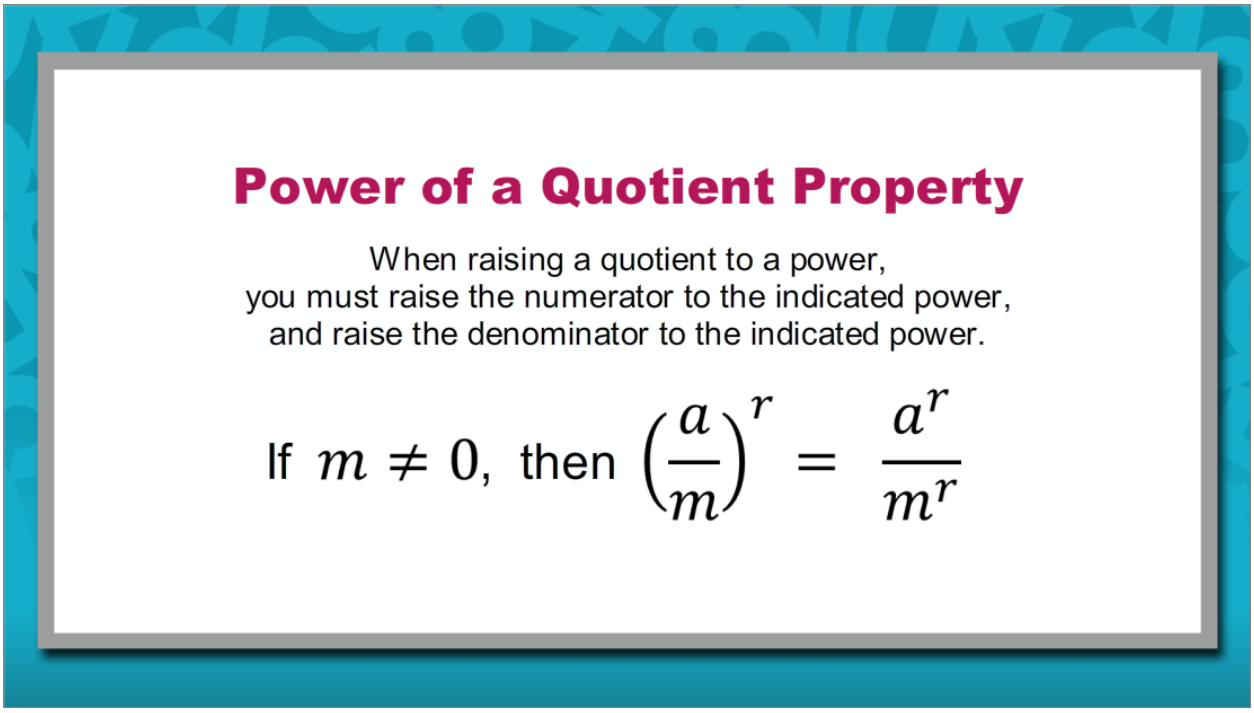
You know that in an exponential expression, the base is the value that is multiplied; the power informs you how many times the base is used as a factor.

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.

Power of a Quotient Property (continued)

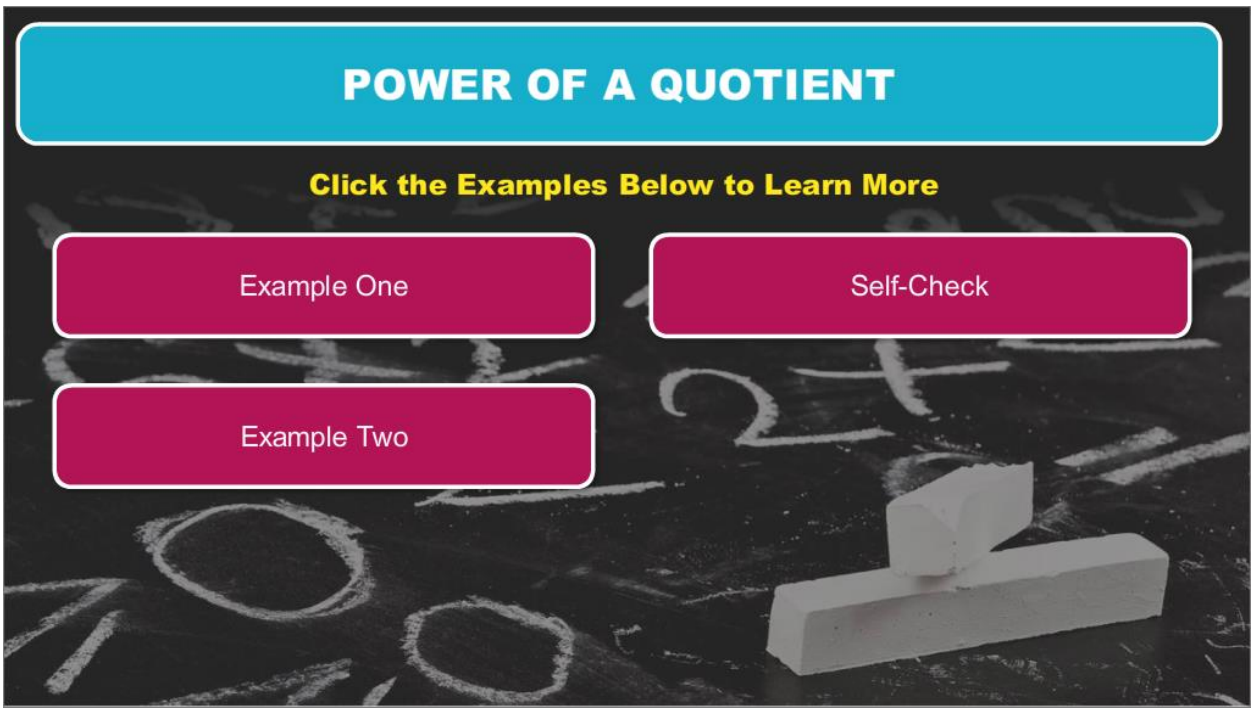


This example shows the pattern that appears when you raise a quotient to a power; you must raise the numerator to the indicated power, and raise the denominator to the indicated power. This is known as the Power of a Quotient Property.

Power of a Quotient Property

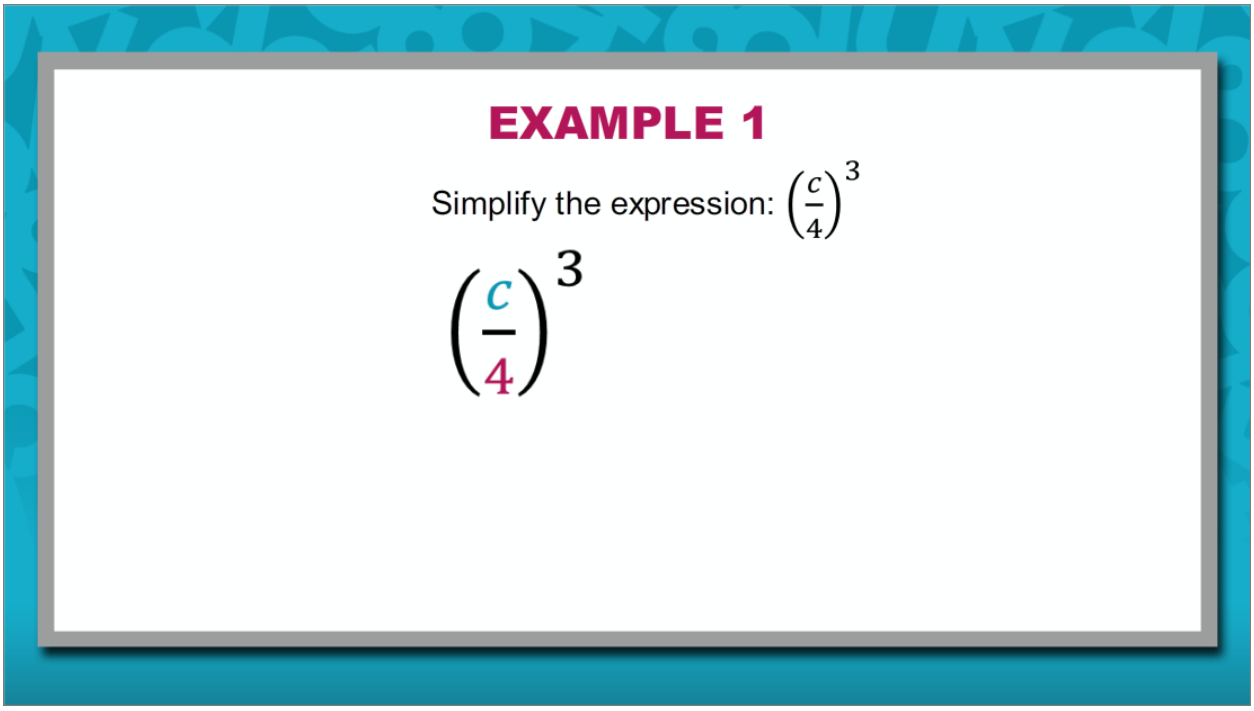
If $m \neq 0$, then $\left(\frac{a}{m}\right)^r = \frac{a^r}{m^r}$.

Power of a Quotient



Click the examples below the learn more.

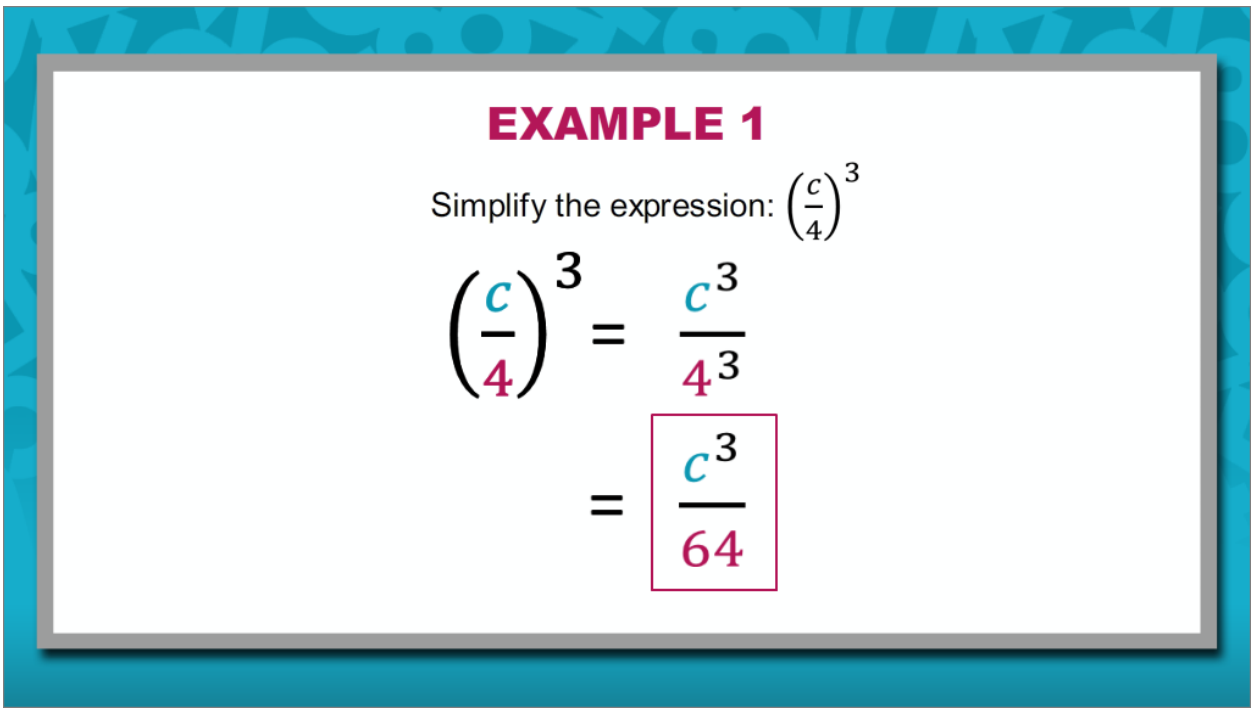
Example 1



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.

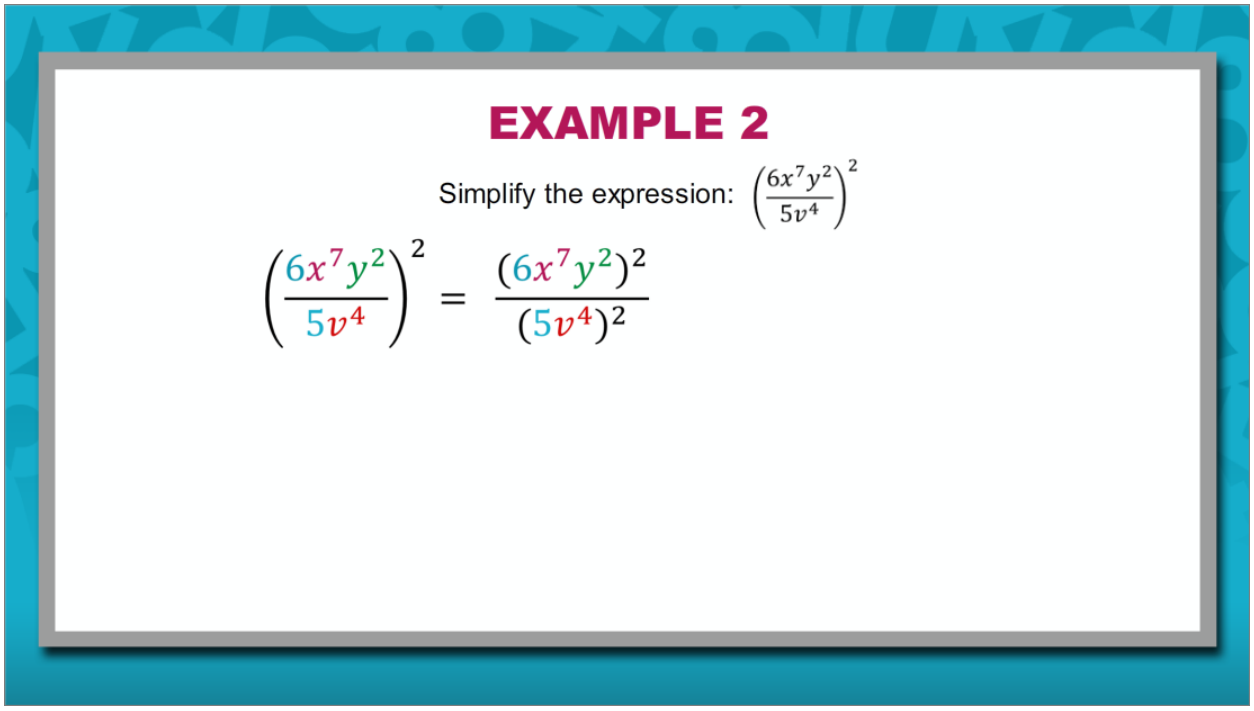
Example 1 (continued)



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 $\frac{c^3}{64}$.

Example 2

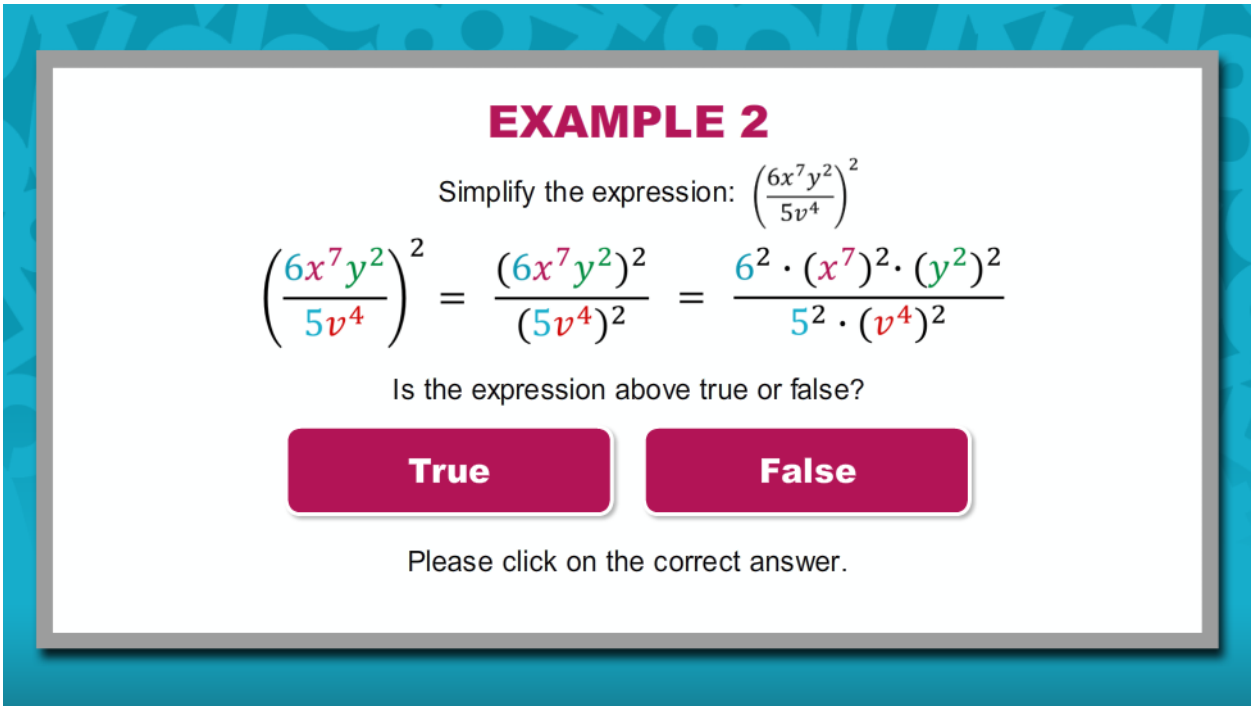


Simplify the expression: $\left(\frac{6x^7y^2}{5v^4}\right)^2$

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

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

Example 2 (continued)



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

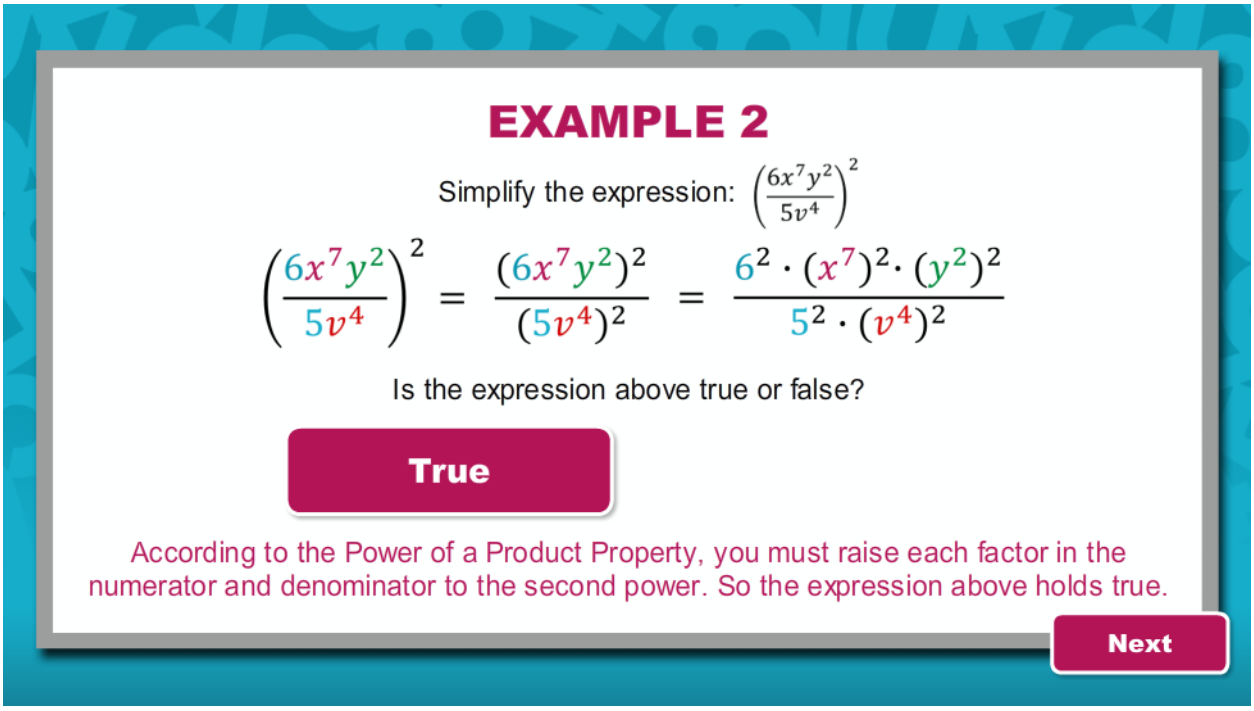
Is the expression above true or false?

A) True

B) False

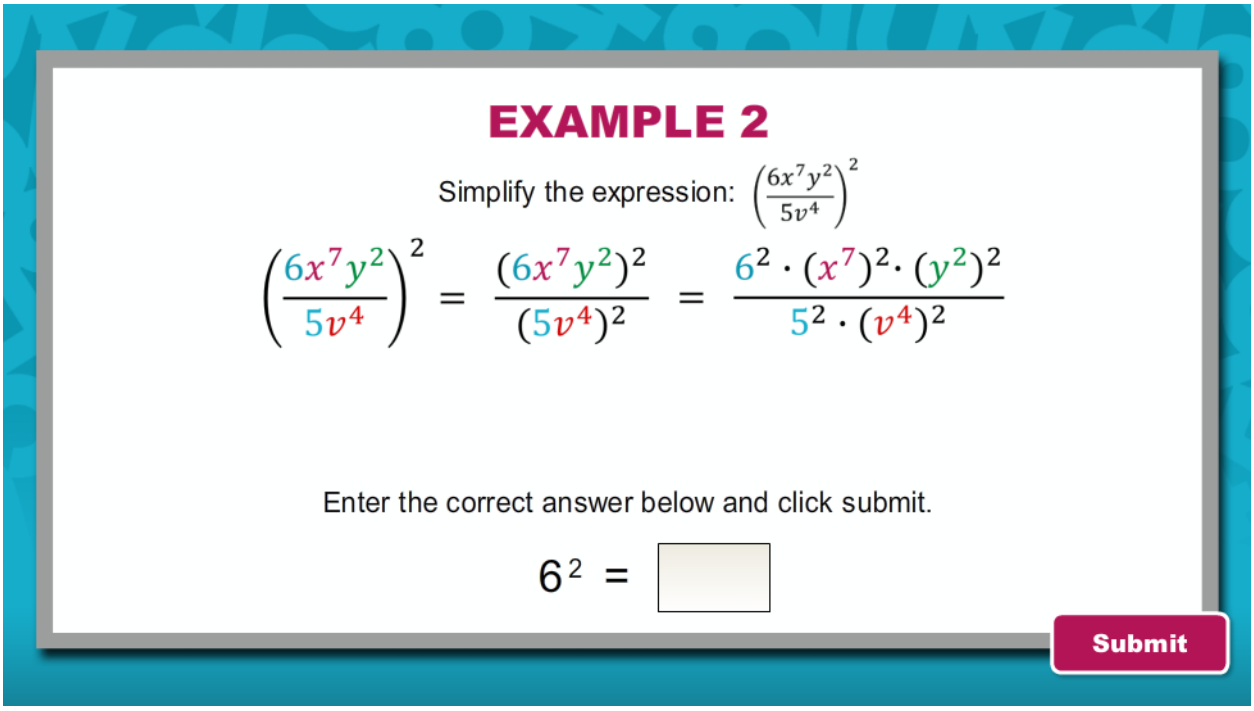
Please click on the correct answer.

Example 2 (continued)



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

Example 2 (continued)

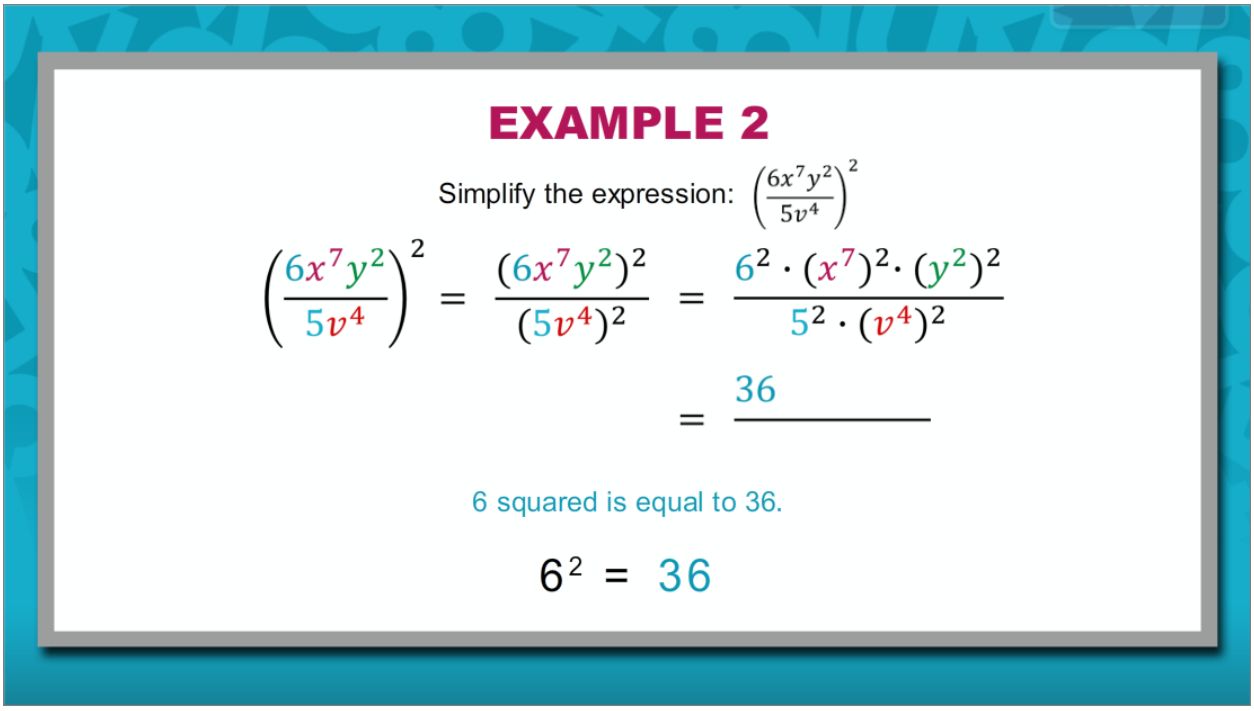


Now simplify the expression in the numerator.

$6^2 = ?$

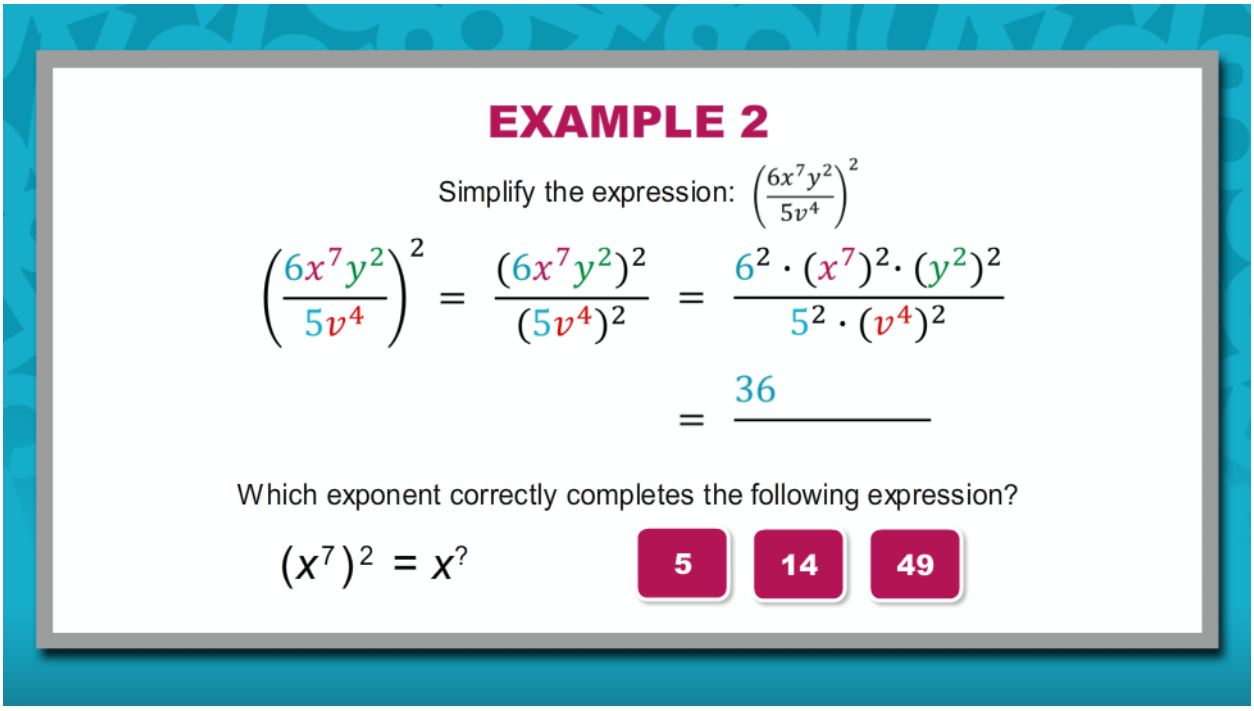
Enter the correct answer below and click submit.

Example 2 (continued)



Feedback: $6^2 = 36$.

Example 2 (continued)



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.

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

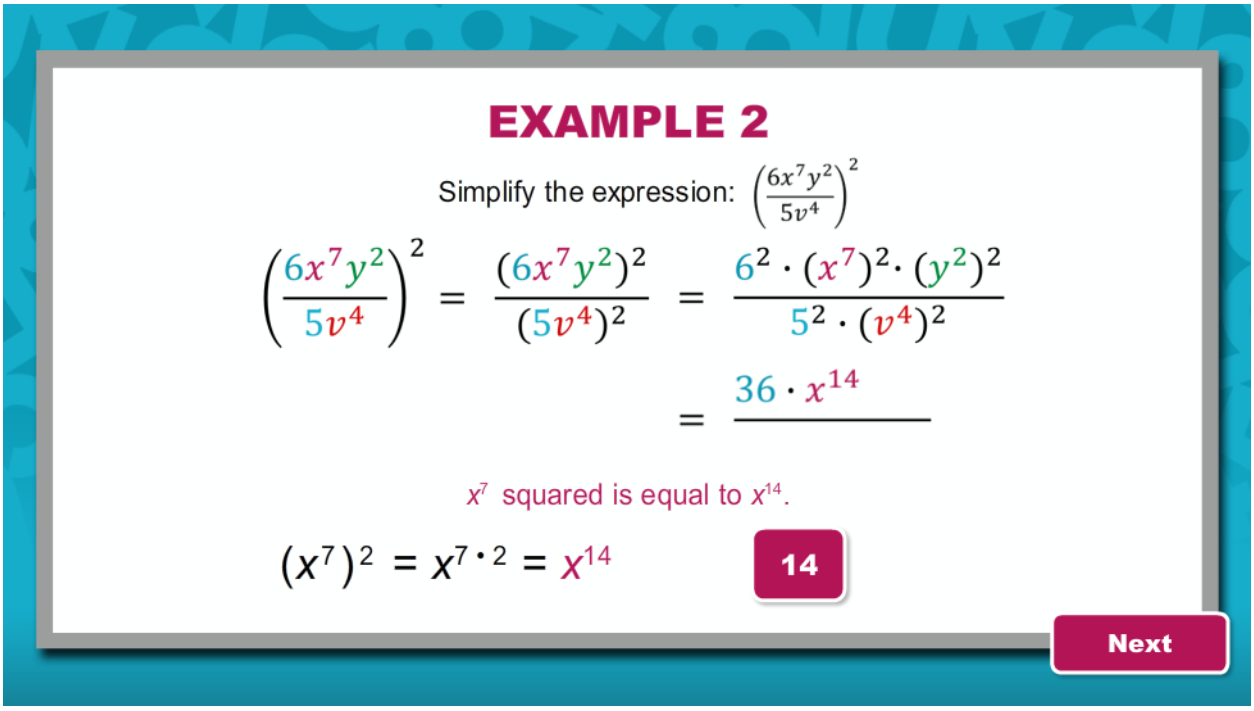
A) 5

B) 14

C) 49

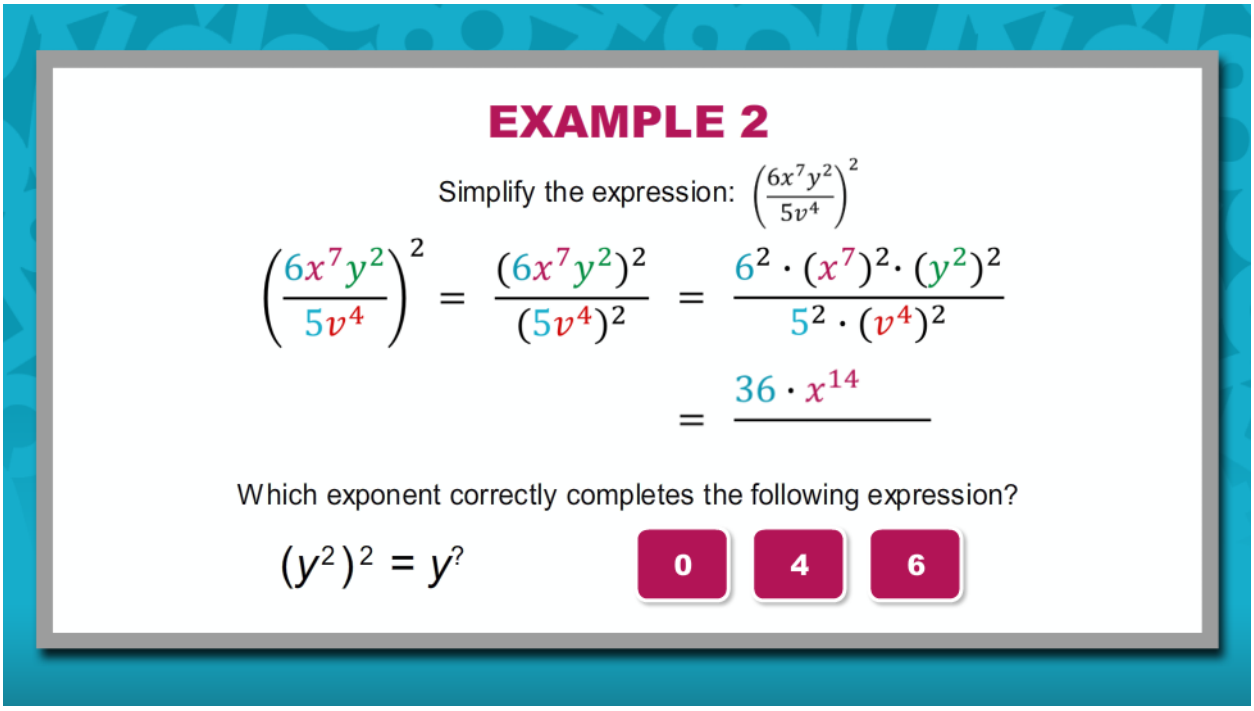
Which exponent correctly completes the following expression?

Example 2 (continued)



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

Example 2 (continued)



Now, raise y^2 to the second power.

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

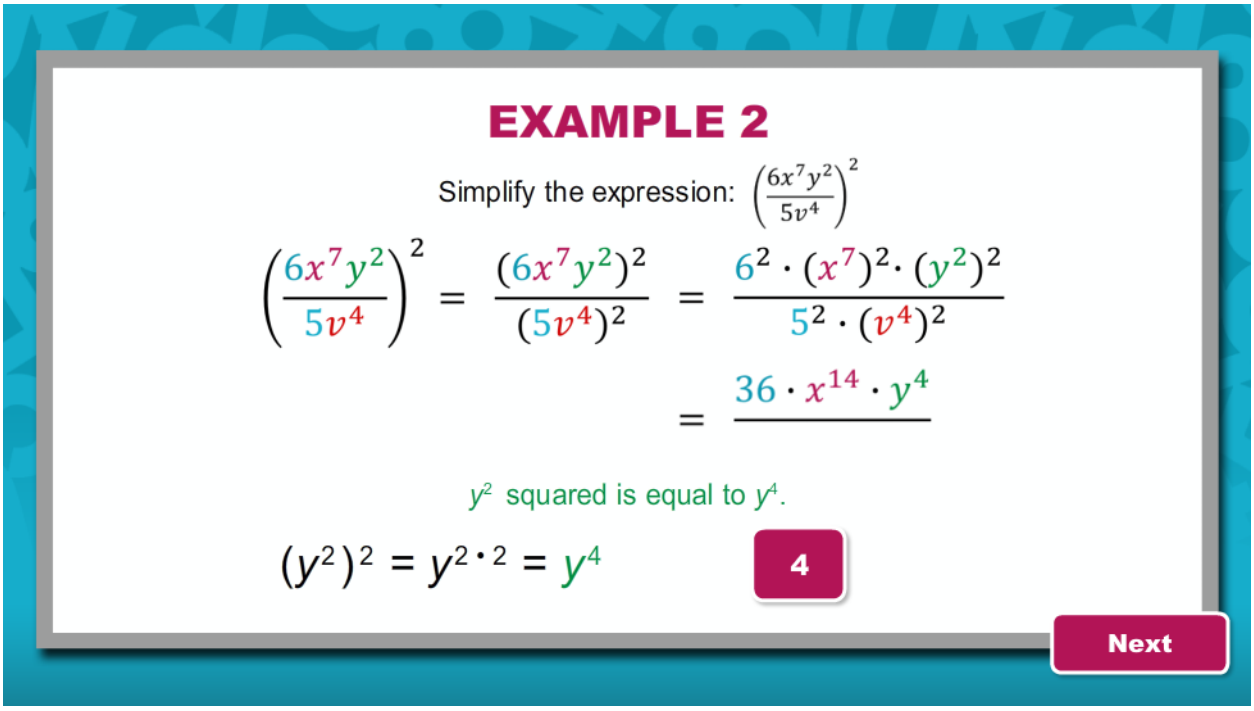
A) 0

B) 4

C) 6

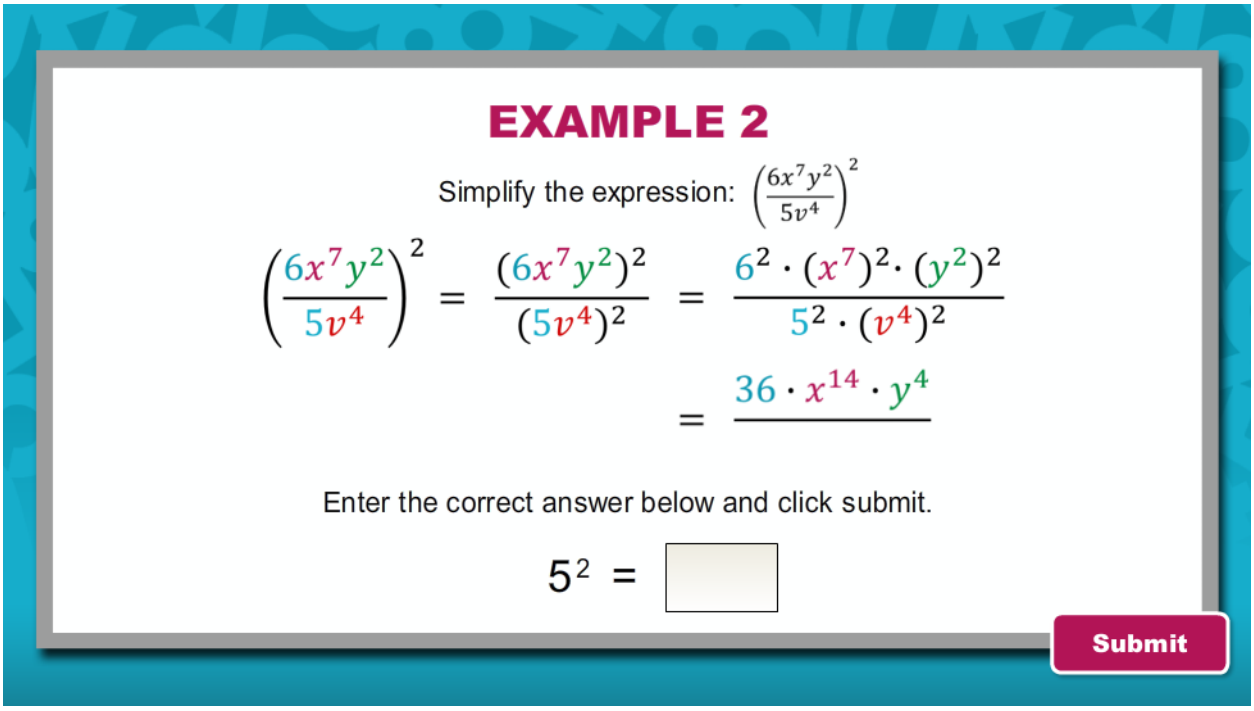
Which exponent correctly completes the following expression?

Example 2 (continued)



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

Example 2 (continued)

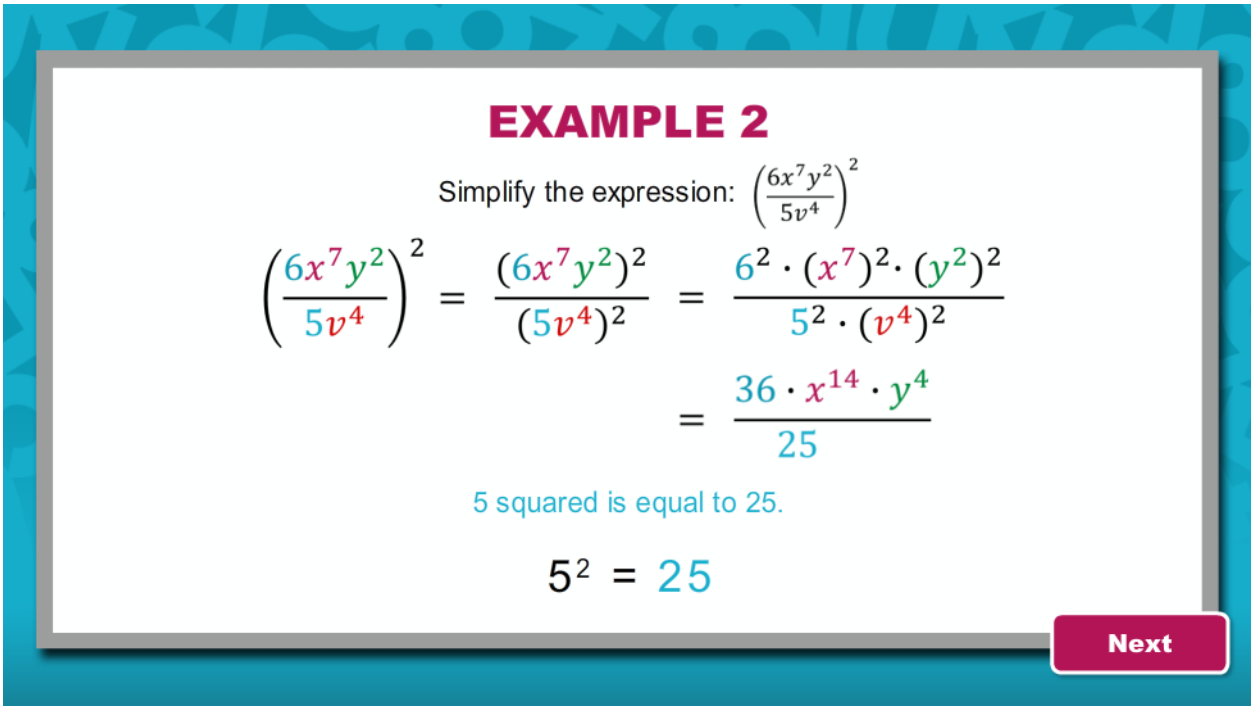


Now simplify the expression in the denominator.

$5^2 = ?$

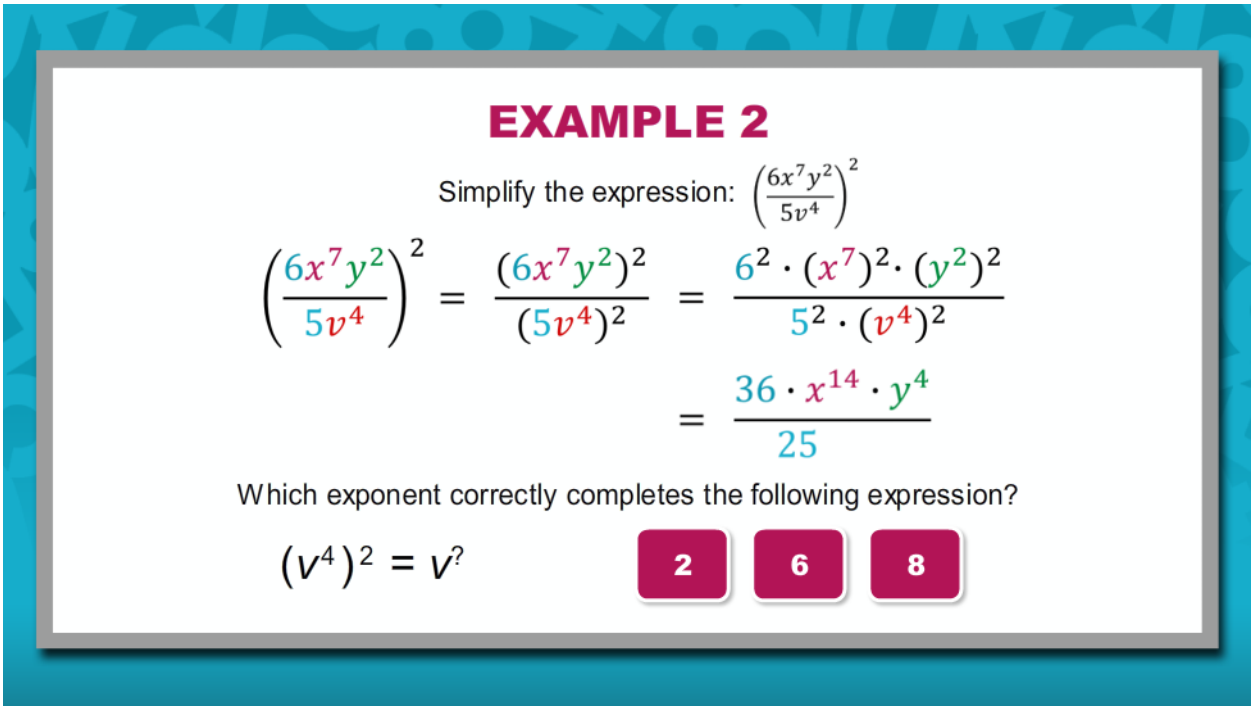
Enter the correct answer below and click submit.

Example 2 (continued)



Feedback: $5^2 = 25$.

Example 2 (continued)



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.

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

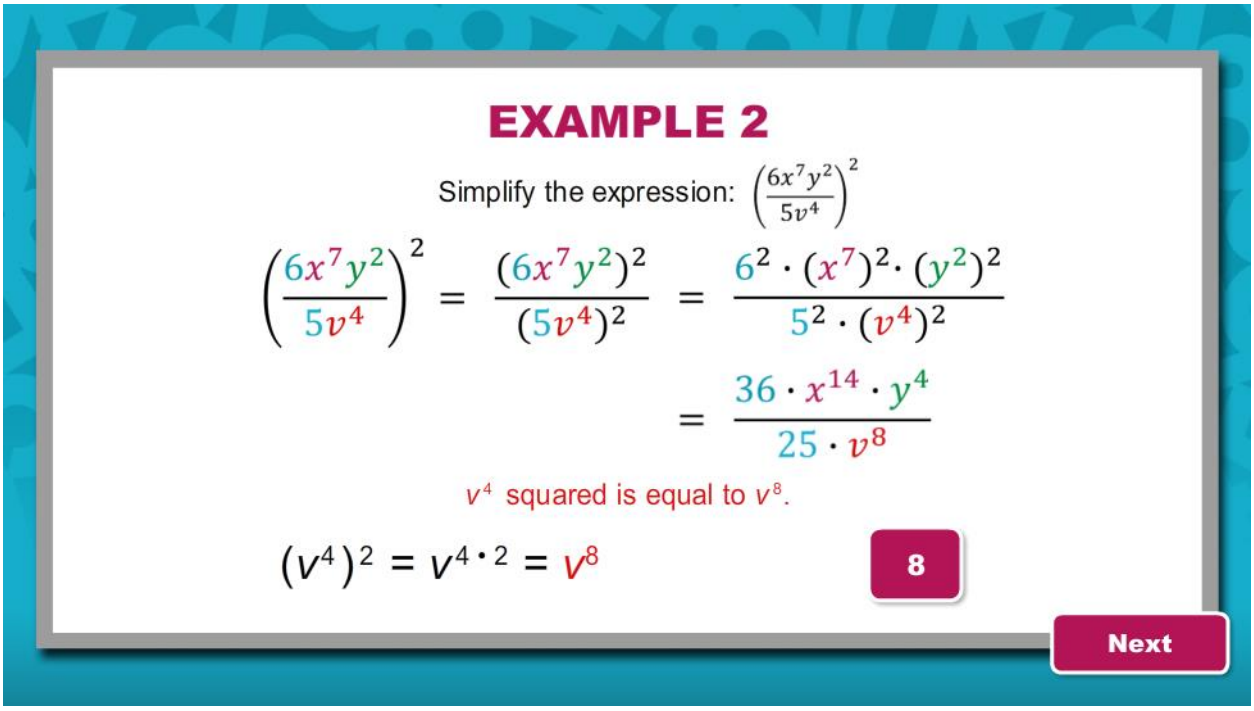
A) 2

B) 6

C) 8

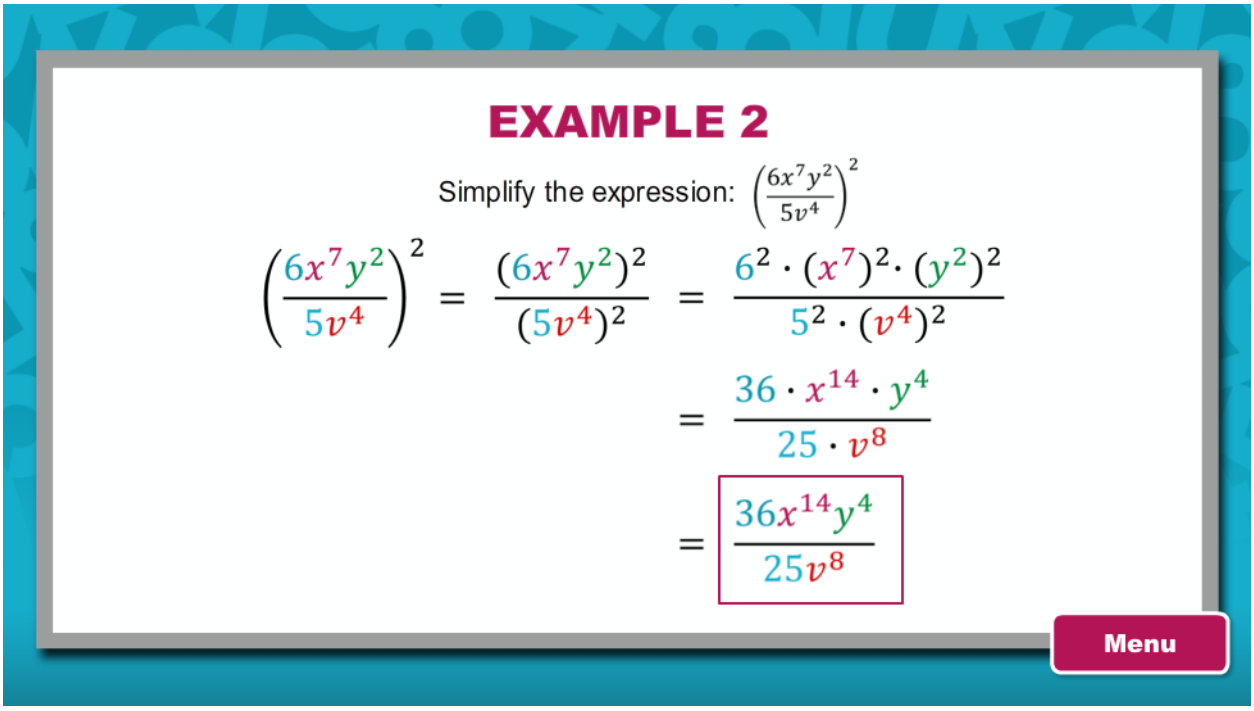
Which exponent correctly completes the following expression?

Example 2 (continued)



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

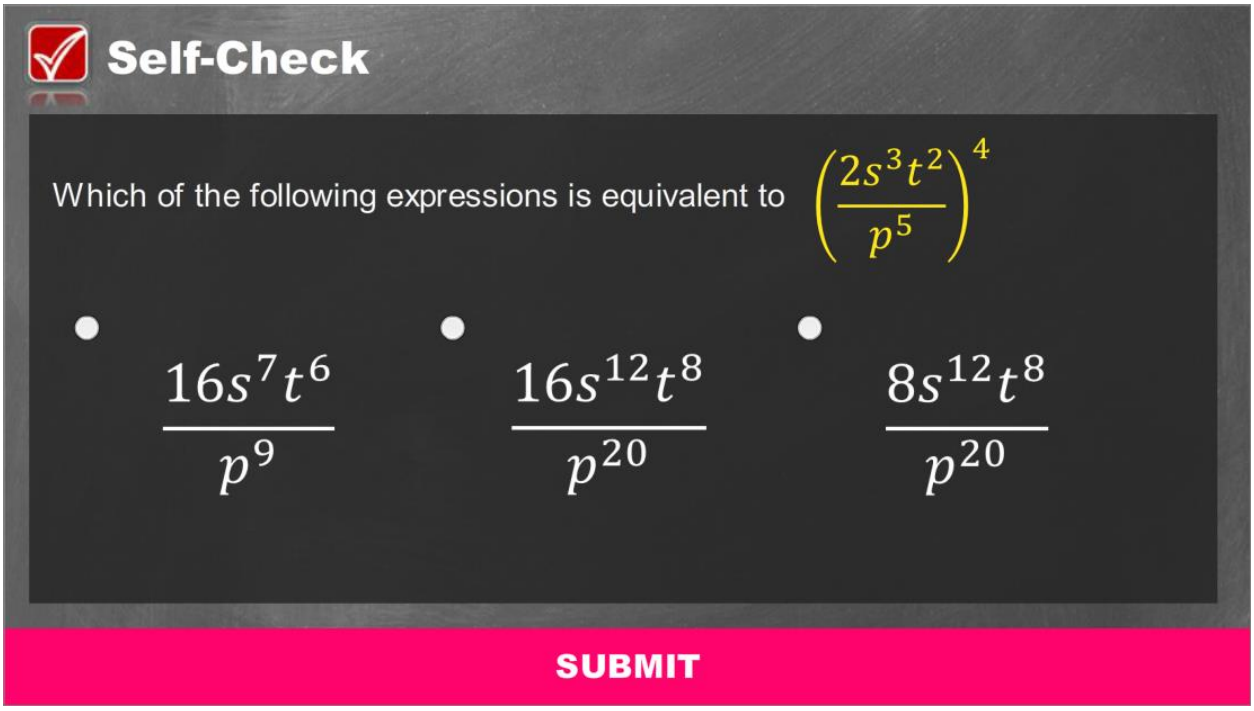
Example 2 (continued)



Now simplify. Your work is complete.

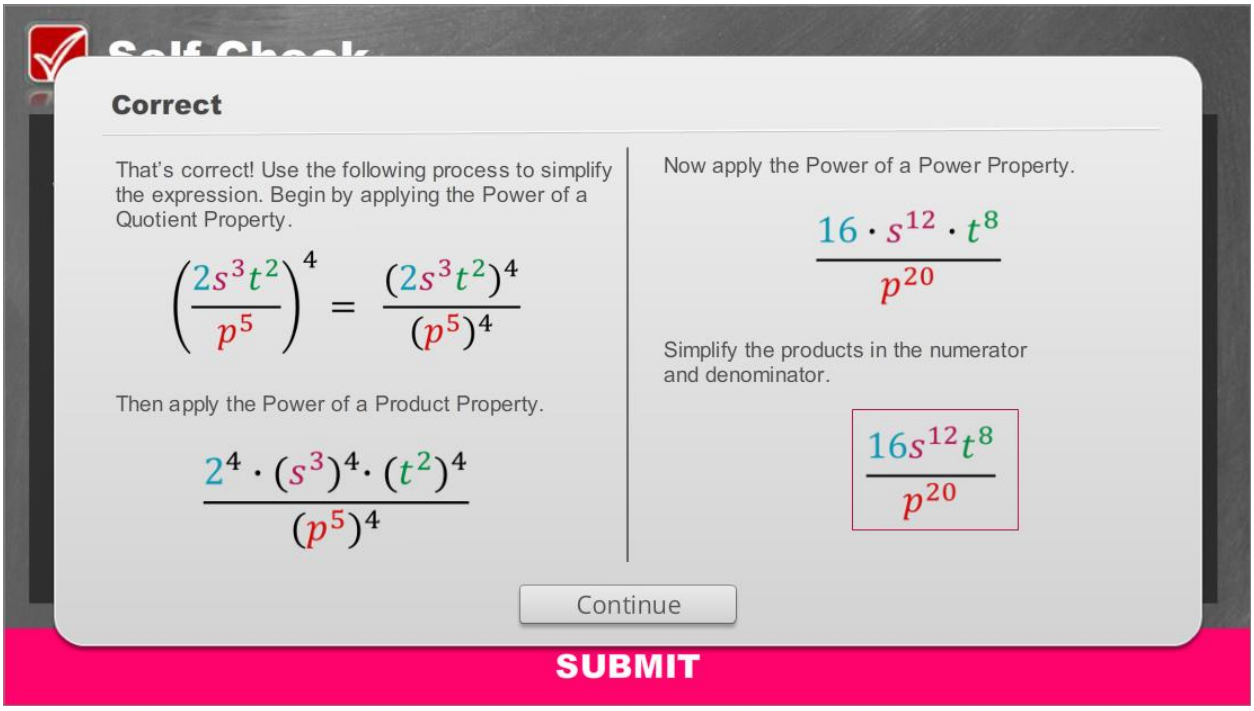
The final answer is $\frac{36\,x^{14}y^4}{25v^8}$.

Self-Check



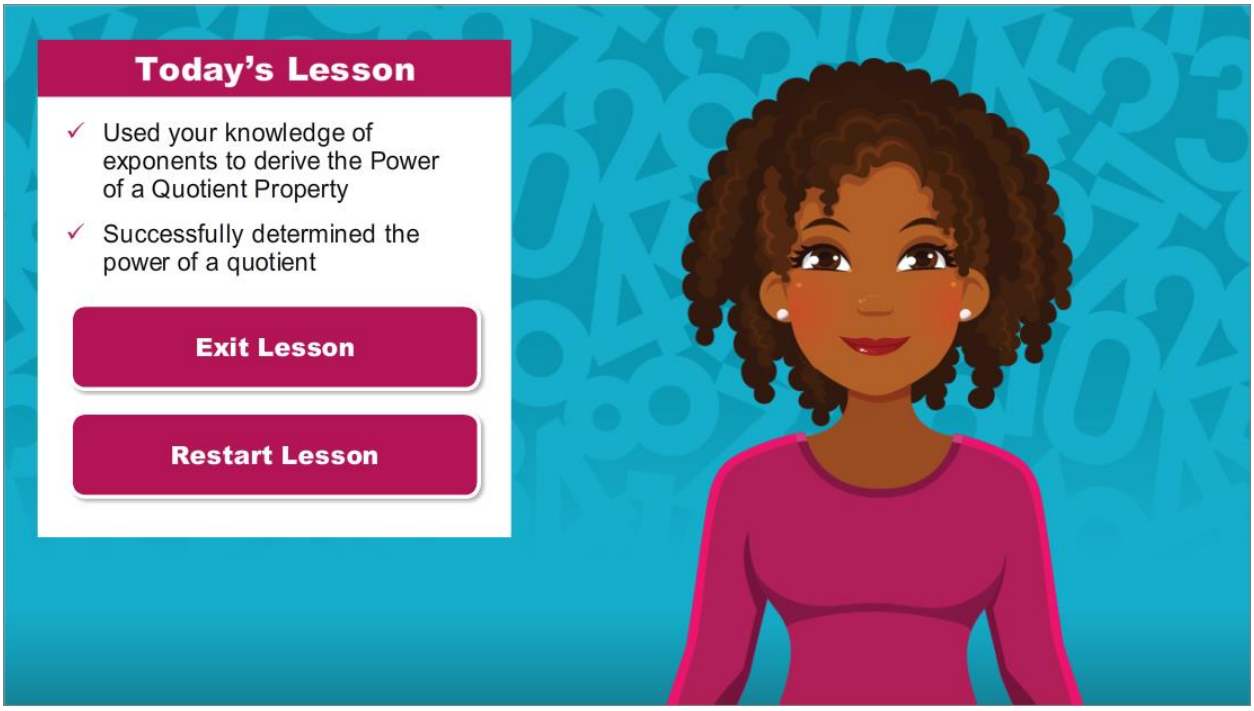
Solve the problem in the image above to check your understanding of the content.

Self-Check: Answer



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

Conclusion



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.