Properties of Exponents Name_____

Product Rule for Exponential Expressions

Use your calculator to simplify each expression below. The ^ key is used to enter an exponent. Then, determine which of the answer choices for each expression is equivalent to your calculator's answer.

$2^3 \cdot 2^5 =$	$(0.5)^4 \cdot (0.5)^2 =$	$\left(\frac{2}{3}\right)^2 \cdot \left(\frac{2}{3}\right)^5 =$
(A) 2^{15}	(A) $(0.5)^2$	(A) $\left(\frac{2}{3}\right)^{10}$
(B) 2^2	(B) $(0.5)^6$	(B) $\left(\frac{2}{3}\right)^7$
(C) 2^8	(C) $(0.5)^8$	(C) $\left(\frac{2}{3}\right)^3$

Look at the results above. Describe the pattern in words.

Pattern:

Do the bases have to be the same for this pattern to hold?

Evaluate $2^3 \cdot 3^4$. Does it equal 6^7?

Express the pattern using symbols.

$b^n \cdot b^m =$

Write and simplify your own problem that demonstrates the **Product Rule**:

Quotient Rule for Exponential Expressions

Use your calculator to simplify each expression below. Determine which of the answer choices for each expression is equivalent to your calculator's answer.

$\frac{2^6}{2^3} =$	$\frac{(0.5)^8}{(0.5)^2} =$	$\frac{\left(\frac{2}{3}\right)^{12}}{\left(\frac{2}{3}\right)^{3}}$
(A) 2^9	(A) $(0.5)^4$	(A) $\left(\frac{2}{3}\right)^{36}$
(B) 2^3	(B) $(0.5)^{10}$	(B) $\left(\frac{2}{3}\right)^{9}$
(C) 2^2	(C) $(0.5)^6$	(C) $\left(\frac{2}{3}\right)^{4}$

Do the bases have to be the same? Explain how you know. Provide a counterexample.

Describe the pattern in words.

Pattern:

Express the pattern using symbols.

$$\frac{b^n}{b^m} =$$

Write and simplify your own problem that demonstrates the **Quotient Rule**:

Zero as an Exponent

Use the quotient rule to simplify $\frac{2^3}{2^3}$.

Simplify $\frac{2^3}{2^3}$. using your calculator.

Based on the results above, what is a good definition for 2^0 ?

Use the quotient rule to simplify $\frac{3^5}{3^5}$.

Evaluate $\frac{3^5}{3^5}$. using your calculator.

Based on the results above, what is a good definition for 3^0 ?

Predict the value of $(0.5)^0$. Check your prediction using your calculator.

Consider 0^0. This could have come from a division such as $\frac{0^3}{0^3}$. What do you know about division by 0?

Is 0^0 defined? Explain.

Write and simplify your own problem that demonstrates what happens when **zero is an exponent**:

Negative Exponents

First, use the quotient rule to simplify each expression. Then use "cancellation" to simplify the expanded expression. Finally, rewrite the expression as a fraction with an exponent on the base in the denominator.

$$\frac{2^6}{2^7} =$$

$$\frac{2^6}{2^7} = \frac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} =$$

$$\frac{(0.5)^3}{(0.5)^5} =$$

$$\frac{(0.5)^3}{(0.5)^5} = \frac{0.5 \cdot 0.5 \cdot 0.5}{0.5 \cdot 0.5 \cdot 0.5 \cdot 0.5 \cdot 0.5} =$$

$$\frac{\left(\frac{2}{3}\right)^2}{\left(\frac{2}{3}\right)^5} =$$

$$\frac{\left(\frac{2}{3}\right)^2}{\left(\frac{2}{3}\right)^5} = \frac{\frac{2}{3} \cdot \frac{2}{3}}{\frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3}} =$$

Write an equivalent expression for x^{-3} using a positive exponent.

Describe in your own words how to change an expression with a negative exponent to an equivalent expression with a positive exponent. Then, write and simplify your own problem containing a **negative exponent**.

Power Rule for Exponential Expressions

Use your calculator to simplify each expression below. Determine which of the answer choices for each expression is equivalent to your calculator's answer.

$(2^3)^5$ (A) 2^8 (B) 2^{243} (C) 2^{15}	$\left[(0.5)^6\right]^2$ (A) $(0.5)^{12}$ (B) $(0.5)^8$ (C) $(0.5)^5$	$\left[\left(\frac{2}{3}\right)^2\right]^3$ (A) $\left(\frac{2}{3}\right)^5$ (B) $\left(\frac{2}{3}\right)^6$ (C) $\left(\frac{2}{3}\right)^8$

Describe the pattern in words.

Pattern:

Express the pattern using symbols.

$(b^n)^m =$

Write and simplify your own problem that demonstrates the **Power Rule**: