Warmup!

Don't copy - lets just do it together!

Review: tricky negatives ...evaluate each of the following.

a) $(-2)^4$ b) -2^4 c) -3^2 d) $(-3)^2$ e) $-(-5)^2$

$= (-2)(-2)(-2)(-2)$
$= 16$

$= -9$

$= 9$

$= -(-5)(-5)$
$= -25$

$= -2 \times 2 \times 2 \times 2$
$= -16$

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4.2 Zero and Negative Exponents

Complete the following chart. Evaluate each to standard form. Leave as whole numbers or fractions.

Expression to be Simplified	Write in Expanded Form	Using Exponent Laws
$\frac{2^3}{2^1}$	$= \frac{2 \times 2 \times 2}{2}$ $= 4$	$2^{3-1} = 2^2$ $= 4$
$\frac{2^3}{2^2}$	$= \frac{2 \times 2 \times 2}{2 \times 2}$ $= 2$	$2^{3-2} = 2^1$ $= 2$
$\frac{2^3}{2^3}$	$= \frac{2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2}$ $= 1$	$2^{3-3} = 2^0$ $= 1$
$\frac{2^3}{2^4}$	$= \frac{2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2 \cdot 2}$ $= \frac{1}{2}$	$2^{3-4} = 2^{-1}$ $= \frac{1}{2^1}$ $= \frac{1}{2}$

HOW is the exponent law expression **RELATED TO** the expanded form expression?

They are the same

What do you notice about the result of an expression with an **exponent of zero**?

They are equal to one

What do you notice about the result of an expression with an **exponent that is negative**?

The term becomes a fraction $\frac{1}{base}$ with an exponent on the base that is positive

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4.2 Zero and Negative Exponents

THE ZERO EXPONENT

Any number (or expression) divided by itself is equal to 1

Use exponent laws to evaluate each of the following:

a) $\frac{2^3}{2^3} = 2^{3-3} = 2^0 = 1$

b) $\frac{x^4}{x^4} = x^{4-4} = x^0 = 1$

Any base to the exponent 0 equals 1

note your BASE cannot be 0

$$a^0 = 1$$

Ex. 1 Evaluate each of the following:

a) $5^0 = 1$

b) $(-3)^0 = 1$

c) $3 \times 2^0 = 3 \cdot 1 = 3$

d) $198643^0 = 1$

e) $-4^0 = -1$

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THE NEGATIVE EXPONENT

Any BASE raised to a NEGATIVE exponent is equal to the reciprocal of the base raised to the same positive exponent. (flip it) and to make it a positive exponent.

$$a^{-m} = \frac{1}{a^m} \quad \text{and} \quad \frac{1}{a^{-m}} = a^m$$

$(4)^{-1} = \frac{1}{4}$

$(-3)^{-5} = \frac{1}{(-3)^5} = \frac{1}{-243}$

$= -3^{-2}$

Ex. 2 Evaluate. No decimals.

a) $8^{-2} = \frac{1}{8^2} = \frac{1}{64}$

b) $(-3)^{-4} = \frac{1}{(-3)^4} = \frac{1}{81}$

c) $1^{-7} = \frac{1}{1^7} = \frac{1}{1} = 1$

d) $-3^{-2} = -\frac{1}{3^2} = -\frac{1}{9}$

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Ex. 3 Evaluate. No decimals.

a) $\left(\frac{1}{4}\right)^{-2}$
$= \left(\frac{4}{1}\right)^{2}$
$= 4^2$
$= 16$

b) $\left(\frac{2}{5}\right)^{-1}$
$= \frac{5}{2}$

c) $\left(\frac{1}{10}\right)^{-3}$
$= \left(\frac{10}{1}\right)^{3}$
$= 10^3$
$= 1000$

d) $\left(\frac{3}{7}\right)^{-2}$
$= \left(\frac{7}{3}\right)^{2}$
$= \frac{7^2}{3^2}$

SIMPLIFYING EXPRESSIONS

The rules for positive exponents also work for zero and negative exponents. Continue to follow the rules for order of operations (BEDMAS) when simplifying & evaluating.

Ex. 4 Use exponent laws to write as a single power, then evaluate. No decimals.

a) $5^3 \times 5^{-5}$
$= 5^{3+(-5)}$
$= 5^{-2}$
$= \frac{1}{5^2}$
$= \frac{1}{25}$

b) $(2^3)^{-2}$
$= 2^{-6}$
$= \frac{1}{2^6}$
$= \frac{1}{64}$

c) $4^{-3} \div 4^{-5}$
$= 4^{-3-(-5)}$
$= 4^{-3+5}$
$= 4^2$
$= 16$

d) $\left(\frac{1}{3^2}\right)\left(\frac{1}{3^{-6}}\right)$
$= 3^{-2} \cdot 3^6$
$= 3^4$
$= 81$

e) $\frac{7^2}{7^4}$
$= 7^{2-4}$
$= 7^{-2}$
$= \frac{1}{7^2}$
$= \frac{1}{49}$

f) $(-2)^3(-2)^{-4}$
$= (-2)^{3+(-4)}$
$= (-2)^{-1}$
$= \frac{1}{-2}$
$= -\frac{1}{2}$

g) $\frac{12^6}{12^6}$
$= 12^{6-6}$
$= 12^0$
$= 1$

h) $\left(\frac{1}{2}\right)^{-5}\left(\frac{1}{2}\right)^{3}$
$= \left(\frac{1}{2}\right)^{-5+3}$
$= \left(\frac{1}{2}\right)^{-2}$
$= (2)^2$
$= 4$

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Ex. 5 Write each number as a power with the stated base

25 (with base of 5)

$= 5^{?}$
$= 5^2$

32 (with base of 2)

$= 2^{?}$
$= 2^5$

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#2ag, 3left column, 8left column

#11ac, 12-15, 16dh

you can try the Interactive work sheet
before you start the practice

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