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Mr. Rogove Date:_____

LEARNING OBJECTIVE: We will simplify expressions that contain negative exponents. (G8M1L5)

CONCEPT DEVELOPMENT:

Recall the following exponent rules:

$x^m \cdot x^n = x^{m+n}$ → Multiplication

$(x^m)^n$ → Raising a power to power

$(xy)^n = x^n y^n$ → Raising a product to a power

$x^0 = 1$ → Raising to the zero power.

Question: What should 7^{-2} mean?

$\frac{7^5}{7^3} = \frac{7\times7\times7\times7\times7}{7\times7\times7} = 7^2$ $\qquad \frac{7^3}{7^5} = \frac{7\times7\times7\times1}{7\times7\times7\times7\times7} = \frac{1}{7\times7} = \frac{1}{7^2} = \frac{1}{49} = 7^{-2}$

Definitions:

$x^{-n} = \frac{1}{x^n}$ $\qquad 7^{-2} = \frac{1}{7^2}$

$\frac{1}{x^{-n}} = x^n$

Examples: $\frac{1}{7^{-2}} = \frac{1}{\frac{1}{49}} = 1 \div \frac{1}{49} = 1\times49 = 49$ $\qquad 8^{-2} = \frac{1}{8^2}$ $\qquad 6^{-9} = \frac{1}{6^9}$ $\qquad \frac{1}{8^{-2}} = 64$

$5^{-3} = \frac{1}{5^3}$ $\qquad \frac{1}{4^{-2}} = 16$

Rewriting Numbers Using Negative Powers of 10

$10^0 = 1$

$\frac{1}{10^1} = 10^{-1} = 0.1$

$\frac{1}{10^2} = 10^{-2} = 0.01$

$\frac{1}{10^3} = \frac{1}{1000} = 10^{-3} = 0.001$

$\frac{1}{10,000} = 10^{-4} = 0.0001$

Example: $328.54 = (3\times10^2) + (2\times10^1) + (8\times10^0) + (5\times10^{-1}) + (4\times10^{-2})$

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Guided Practice:

Write a simplified expression that is equivalent to the given one.

3×10^{-2} $3\times\frac{1}{10^2}=\frac{3}{10^2}=\frac{3}{100}$ $.03$	2×10^{-4} $\frac{2}{10{,}000}=.0002$
Write the expanded form in exponential notation: 12.345 $(1\times10^1)+(2\times10^0)+(3\times10^{-1})+(4\times10^{-2})+(5\times10^{-3})$ $10+2+.3+.04+.005$	Write the expanded form in exponential notation: 4.728 $(4\times10^0)+(7\times10^{-1})+(2\times10^{-2})+(8\times10^{-3})$
x^1y^{-4} $\frac{x}{1}\cdot\frac{1}{y^4}=\boxed{\frac{x}{y^4}}$	$3^1\cdot4^{-7}$ $\boxed{\frac{3}{4^7}}$ $4^{-7}=\frac{1}{4^7}$
$\frac{19^2}{19^5}=19^{2-5}$ $19^{-3}=\frac{1}{19^3}$	$\frac{17^6}{17^{-3}}$ $17^{6-(-3)}=\boxed{17^9}$

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$(3xy)^{-2}$ $\frac{1}{(3xy)^2} = \frac{1}{9x^2y^2}$ $3^{-2}x^{-2}y^{-2} = \frac{1}{9x^2y^2}$	$(4g)^{-5}$ $\frac{1}{4^5g^5}$ $\frac{1}{1024g^5}$
$(4^1x^3)^{-4}$ $4^{-4}x^{-12}$ $\frac{\frac{1}{4^4x^{12}}}{\frac{1}{256x^{12}}}$ $\frac{1}{(4x^3)^4} = \frac{1}{4^4x^{12}}$	$(x^2y^{-3})^{-8}$ $\frac{x^{-16}y^{24}}{1} = \frac{y^{24}}{x^{16}}$ $x^{-16} = \frac{1}{x^{16}}$
$\left(\frac{3}{4}\right)^{-4}$ $\frac{3^{-4}}{4^{-4}} = \frac{4^4}{3^4}$	$\left(\frac{78}{5}\right)^{-5}$ $\frac{78^{-5}}{5^{-5}}$ $\frac{5^5}{78^5}$

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Independent Practice:

ab^{-1}	$\frac{4^0}{w^{-4}}$
$\frac{3x^{-4}}{y}$	$\frac{n^{-5}}{n^{-8}v^2}$
$\frac{6x^{-4}y^{-4}}{4x^{-7}}$	$\frac{8a^{-1}}{2c^{-3}}$
$(4s^3t^{-3}v^0)^{-6}$	$(2^{-3}d^{-3}f^4)^{-7}$

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Activating Prior Knowledge:

We know how to multiply and divide exponents in the context of having zero exponents

$4^0 \cdot 4^7$ 16^7 4^7 $4^0 = 1$ $16^0 = 1$	$\frac{5^8}{5^8} = 5^0$ 1 5^{8-8}

Closure:

Identify each of the following as either negative, between 0 and 1, or more than 1.

A. -2^2 = -4

B. $(-2)^2$ = 4

C. 2^{-2} = $\frac{1}{4}$

D. -2^3 = -8

E. $(-2)^{-3}$ = $-\frac{1}{8}$

Teacher Notes:

Yummy Math: Negative Exponents-Ugh!