8.3: Zero and Negative Exponents

Goals: *Simplify expressions raised to the zero power
*Rewrite expressions using all positive exponents

Zero Exponents:

****NOTICE****

$2^5 = 32$

$2^4 = 16$

$2^3 = 8$

$2^2 = 4$

$2^1 = 2$

$2^0 = ?$ (Since the pattern is that you keep dividing by 2, the next number would be 1)

$5 \cdot 1 = 5$
$4 \cdot 1 = 4$
$b \cdot 1 = b$
Anything times 1 is _itself_!

****PROOF****

and $x^m \cdot x^n = x^{m+n}$

$x^3 \cdot \_1\_ = x^3$

$x^3 \cdot x^? = x^{3+?} = x^3$

Because the rule is to add the exponents when you multiply, zero would be the missing exponent

1) $a^0 = 1$ $a \neq 0$, a can be negative, positive, fraction, decimal…

2) $a^{-m} = \frac{1}{a^m}$ and $\frac{1}{a^{-m}} = a^m$

Negative Exponents:

****NOTICE****

$2^2 = 4$

$2^1 = 2$

$2^0 = 1$ (Just learned and proved)

$2^{-1} = ½$ (Pattern) $= \frac{1}{2^?}$ $\frac{1}{2^1}$

$2^{-2} = ¼$ $= \frac{1}{2^?}$ $\frac{1}{2^2}$

****PROOF****

$\frac{a^m}{a^n} = a^{m-n}$

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

$\frac{2 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \quad = \frac{1}{2^?}$ $\frac{1}{2^1}$

Simplify the following expressions. Write your answer using positive exponents.

Ex: $\left(\frac{2}{3}\right)^0$

1

Ex: $(-1)^0$

1

Ex: x^{-2}

$\frac{1}{x^2}$

Ex: 4^{-3}

$\frac{1}{4^3} = \frac{1}{64}$

Ex: $(-8)^{-2}$

$\frac{1}{64}$

Ex: $\frac{1}{y^{-3}}$

$\frac{1}{\frac{1}{y^3}} = 1 \div \frac{1}{y^3} = \frac{1}{1} \cdot \frac{y^3}{1} = y^3$

Ex: $\frac{1}{2^{-3}}$

8

Putting it all together.

Ex: $\frac{7^3}{7^5}$

$\frac{1}{49}$

Ex: $(2xy^{-5})^3$

$\frac{8x^3}{y^{15}}$

Ex: $(3x^{-2}y^2)^3$

$\frac{27y^6}{x^6}$

Ex: $\frac{5^{-1}}{5^2}$

$\frac{1}{125}$

Some more complicated ones:

Ex: $\left(\frac{2}{3}\right)^{-2}$

$\frac{9}{4}$

Ex: $\frac{(2x)^{-2}y^5}{-4x^2y^2}$

$-\frac{y^3}{16x^4}$

Ex: $\frac{4x^{-2}y^4}{8xy^6}$

$\frac{1}{2x^3y^2}$