1.4 Negative and Zero Exponents

Math 10 1.4 **Negative and Zero Exponents** Name: _______________

We know that exponents are used to simplify repeated multiplication expressions. For example,

$$3\times3\times3\times3\times3\times3\times3=3^7$$

But what do expressions like 2^{-5} or 8^0 mean? Let's work backwards to figure this out.

2^3	$2\times2\times2=8$
2^2	$2\times2=4$
2^1	2
2^0	1
2^{-1}	$\frac{1}{2}$
2^{-2}	$\frac{1}{4}=\frac{1}{2^2}=\frac{1}{2\times2}$
2^{-3}	$\frac{1}{8}=\frac{1}{2^3}=\frac{1}{2\times2\times2}$

$\div 2$ $\div 2$ $\div 2$ $\div 2$ $\div 2$ $\div 2$

$$\boxed{x^{-m}=\frac{1}{x^m}\ ;\ \frac{1}{x^{-m}}=x^m}$$

*any power with exponent 0 is equal to 1

$5^0=1 \quad a^0=1$

$(871\times\frac{1}{41}+3)^0=1$

Rewrite each power with a positive exponent, then evaluate.

$7^{-2}=\frac{1}{7^2}=\frac{1}{49}$ $\quad 8^{-1}=\frac{1}{8^1}=\frac{1}{8}$ $\quad 3^0=1$

exponent only applies to the 4

$-4^0=-1$ $\quad (-2)^{-5}=\frac{1}{(-2)^5}=\frac{1}{-32}$ $\quad (-2)^{-4}=\frac{1}{(-2)^4}=\frac{1}{16}$

$(-4)^0=1$

$-9^{-2}=-\frac{1}{9^2}=-\frac{1}{81}$ $\quad \left(\frac{1}{2}\right)^{-3}=\left(\frac{2}{1}\right)^3=\frac{8}{1}=8$ $\quad \left(-\frac{3}{4}\right)^{-1}=\left(-\frac{4}{3}\right)^1=-\frac{4}{3}$

$\left(\frac{2}{3}\right)^{-3}=\left(\frac{3}{2}\right)^3=\frac{27}{8}$ $\quad \left(-\frac{2}{3}\right)^{-3}=\left(-\frac{3}{2}\right)^3=-\frac{27}{8}$ $\quad 5^{-1}+(6-2)^0=\frac{1}{5}+1=1\frac{1}{5}$

Write the fraction $\frac{1}{16}$ as a power of 2. $\frac{1}{16} = \frac{1}{2^4}$

Simplify and rewrite each with only positive exponents.

$a^{-4} \times a^{-3} = a^{-7} = \frac{1}{a^7}$ $\quad$ $6x^2 \div 2x^7 = 3x^{-5} = \frac{3}{x^5}$ $\quad$ $\frac{y^6}{2y^{-5}} = \frac{y^6 \cdot y^5}{2} = \frac{y^{11}}{2}$

$(-2x)^{-3} = \frac{1}{(-2x)^3} = \frac{1}{-8x^3}$ $\quad$ $\frac{8a^{-5}}{4b^{-3}} = \frac{2b^3}{a^5}$ $\quad$ $\frac{(5p)^{-2}}{5q^4} = \frac{1}{5q^4(5p)^2}$

$= \frac{1}{5q^4(25p^2)}$

$= \frac{1}{125p^2q^4}$

Practise:

Simplify and rewrite each expression using only positive exponents.

$3^{-2} =$ $\quad$ $14^{-1} =$ $\quad$ $-(-2)^0 =$ $\quad$ $(-4)^{-3} =$ $\quad$ $-5^{-2} =$

$\left(\frac{3}{4}\right)^{-2} =$ $\quad$ $\left(-\frac{7}{12}\right)^{-1} =$ $\quad$ $\left(-\frac{5}{8}\right)^{0} =$ $\quad$ $\left(-\frac{5}{2}\right)^{-3} =$ $\quad$ $-\left(\frac{1}{2}\right)^{-6} =$

$(4^3)(4^{-5}) =$ $\quad$ $\frac{3^{-4}}{3^{-2}} =$ $\quad$ $\frac{12^3}{12^7} =$ $\quad$ $\left(\frac{8^{-1}}{8^0}\right)^3 =$ $\quad$ $(5^4)^{-2} =$

$\frac{1}{s^2t^{-6}} =$ $\quad$ $\frac{8t}{t^{-3}} =$ $\quad$ $\left(\frac{n^4}{n^{-4}}\right)^{-3} =$ $\quad$ $[(xy^4)^{-3}]^{-2} =$ $\quad$ $[(h^7)(h^{-2})]^{-2} =$