Date: _____

Zero and Negative Exponents

Learning Target: We are learning to... determine the rules for working with zero and negative exponents.

Success Criteria: I can... determine the rules for working with zero and negative exponents.

Zero Exponents: Complete the chart.

Simplify using exponent laws:	Evaluate:	Conclusion:
(a) $\frac{4^3}{4^3} = 4^{3-3} = 4^0$	$\frac{4^3}{4^3} = 1$	$4^0 = 1$
(b) $\frac{7^4}{7^4} = 7^{4-4} = 7^0$	$\frac{7^4}{7^4} = 1$	$7^0 = 1$
(c) $\frac{5^2}{5^2} = 5^{2-2} = 5^0$	$\frac{5^2}{5^2} = 1$	$5^0 = 1$
(d) $\frac{(-3)^3}{(-3)^3} = (-3)^{3-3} = (-3)^0$	$\frac{(-3)^3}{(-3)^3} = 1$	$(-3)^0 = 1$

What can you say about simplifying powers with zero exponents?

They always are equal to ONE!

In general, $x^0 = 1 \ (x \neq 0)$

Be careful:

(a) $5^0 = 1$ (b) $(-5)^0 = 1$ (c) $-5^0 = -1$

Negative Exponents: Complete the chart.

Simplify using exponent laws:	Write in expanded form then reduce to a simpler power	Conclusion:
(a) $\frac{2^2}{2^3} = 2^{2-3} = 2^{-1}$	$\frac{2^2}{2^3} = \frac{2 \cdot 2}{2 \cdot 2 \cdot 2} = \frac{1}{2}$	$2^{-1} = \frac{1}{2}$
(b) $\frac{3^4}{3^5} = 3^{4-5} = 3^{-1}$	$\frac{3^4}{3^5} = \frac{3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3} = \frac{1}{3}$	$3^{-1} = \frac{1}{3}$
(c) $\frac{(-5)^6}{(-5)^7} = (-5)^{6-7} = (-5)^{-1}$	$\frac{(-5)^6}{(-5)^7} = \frac{(-5)(-5)(-5)(-5)(-5)(-5)}{(-5)(-5)(-5)(-5)(-5)(-5)(-5)} = \frac{1}{(-5)}$	$(-5)^{-1} = \frac{1}{(-5)}$
In general, $x^{-1} = \frac{1}{x}$		

(d) $\frac{6^2}{6^4} = 6^{2-4} = 6^{-2}$	$\frac{6 \cdot 6}{6 \cdot 6 \cdot 6 \cdot 6} = \frac{1}{6^2}$	$6^{-2} = \frac{1}{6^2}$
(e) $\frac{4^3}{4^7} = 4^{3-7} = 4^{-4}$	$\frac{4 \cdot 4 \cdot 4}{4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4} = \frac{1}{4^4}$	$4^{-4} = \frac{1}{4^4}$
(f) $\frac{(-2)^2}{(-2)^5} = (-2)^{2-5} = (-2)^{-3}$	$\frac{(-2)(-2)}{(-2)(-2)(-2)(-2)(-2)} = \frac{1}{(-2)^3}$	$(-2)^{-3} = \frac{1}{(-2)^3}$
In general, $x^{-n} = \frac{1}{x^n}$		

Practise: Write with a positive exponent, then evaluate where possible. NO Calculators!

(1) 2^{-5}

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

$= \frac{1}{32}$

(2) -2^{-5}

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

$= \frac{-1}{32}$

(3) $(-2)^{-5}$

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

$= \frac{-1}{32}$

(4) $\left(\frac{5}{7}\right)^{-1}$

$= \left(\frac{7}{5}\right)^{1}$

$= \frac{7}{5}$

(5) $\left(\frac{1}{3}\right)^{-2}$

$= \left(\frac{3}{1}\right)^{2}$

$= 3^2$

$= 9$

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

$= \frac{2^3}{5^3}$

$= \frac{8}{125}$

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

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

$= \frac{5^3}{2^3}$

$= \frac{125}{8}$

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

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

$= \frac{-3^2}{7^2}$

$= \frac{-9}{49}$

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

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

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

$= \frac{49}{9}$

(10) $\left(\frac{1}{3}\right)^{2}$

$= \frac{1^2}{3^2}$

$= \frac{1}{9}$

Determine the value of n which makes each statement true.

(1) $12^n = 1$

$12^n = 12^0$

$n = 0$.

(2) $-2^n = -\frac{1}{4}$

$-2^n = -\frac{1}{2^2}$

$-2^n = -2^{-2}$

$n = -2$

(3) $n^{-3} = \frac{1}{8}$

$n^{-3} = \frac{1}{(2)^3}$

$n^{-3} = 2^{-3}$

$n = 2$

(4) $(-n)^3 = -125$

$(-n)^3 = (-5)^3$

$n = 5$

Homework: CP p. 68-69 (odd letters), CP p. 70 (odd letters), and Textbook p. 228 #6–9