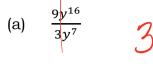# Zero and Negative Exponent Rules

Aim: *How can we create a rule when we have exponents that are zero and negative?*

Warm Up: Simplify the following expressions.

(a) $\dfrac{9y^{16}}{3y^7}$ $3y^9$

(b) $\dfrac{5x^3y^6}{1\,xy}$ $5x^2y^5$

Discovery to the Zero Exponent Rule

What happens when you raise a number to a zero power? Look for a pattern as you fill in the table below. Then, evaluate each expression using what you know about dividing a number by itself.
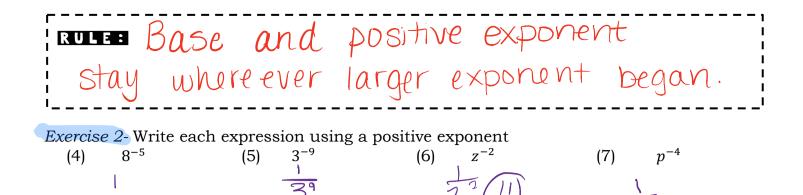
Expression	Expanded Form	Exponential Form	Evaluate
$\dfrac{5^6}{5^6}$	$\dfrac{5\cdot5\cdot5\cdot5\cdot5\cdot5}{5\cdot5\cdot5\cdot5\cdot5\cdot5}$	5^0	1
$\dfrac{x^5}{x^5}$	$\dfrac{x\cdot x\cdot x\cdot x\cdot x}{x\cdot x\cdot x\cdot x\cdot x}$	x^0	1
$\dfrac{(-4)^3}{(-4)^3}$		$(-4)^0$	1

RULE: Any number raised to the **zero** power will ALWAYS be __**1**__.

Note this works when $x \neq 0$ ___$0^0 = 0$___

Exercise 1- Evaluate the following

(1) $(-9821)^0 = 1$

(2) $(4x)^0 = 1$

(3) $4x^0$
$4\cdot1 = \boxed{4}$

Discovery to the Negative Exponent Rule

What happens when you raise a number to a negative power? Look for a pattern in the table below.

Expression	Expanded Form	Exponential Form	As a Fraction
$\dfrac{2^2}{2^5}$	$\dfrac{2\cdot2}{2\cdot2\cdot(2\cdot2\cdot2)}$	2^{-3}	$\dfrac{1}{2^3}$
$\dfrac{4^4}{4^{10}}$		4^{-6}	$\dfrac{1}{4^6}$
$\dfrac{(-9)^2}{(-9)^7}$		$(-9)^{-5}$	$\dfrac{1}{(-9)^5}$
$\dfrac{a^6b^5}{a^9b^{12}}$	$\dfrac{1}{a^3b^7}$		

Exercise 2- Write each expression using a positive exponent

(4) 8^{-5}

$\frac{1}{8^5}$

(5) 3^{-9}

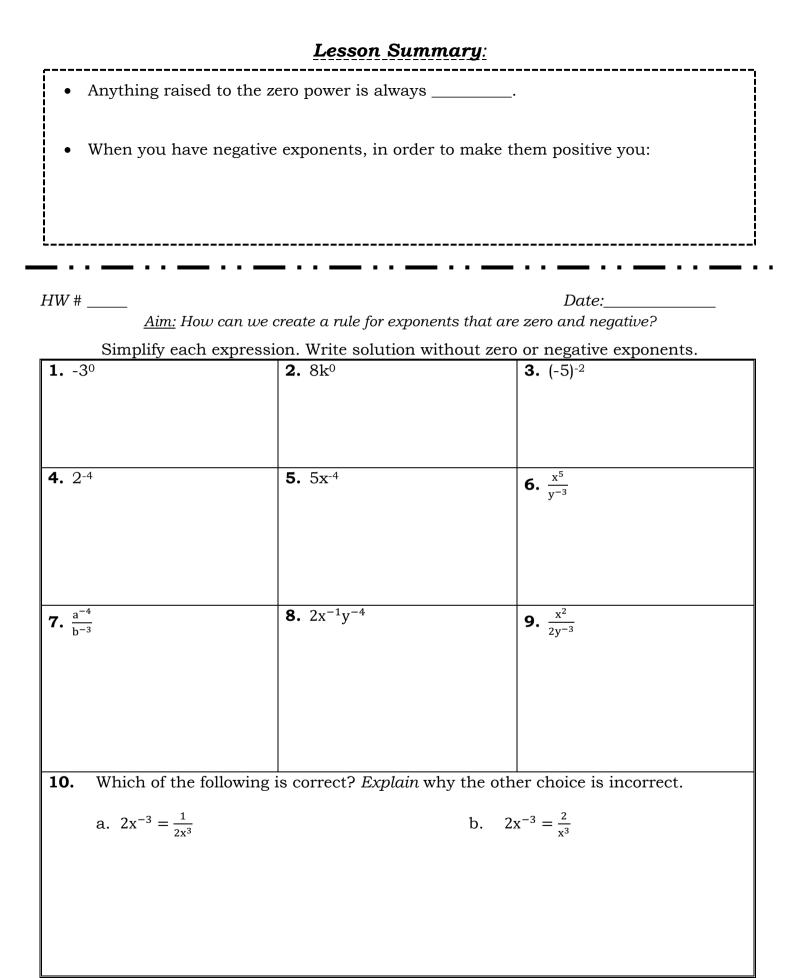$\frac{1}{3^9}$

(6) z^{-2}

$\frac{1}{z^2}$ ☺

(7) p^{-4}

$\frac{1}{p^4}$

Problem Set: *Putting it all together.*

Simplify each expression and re-write with a *positive* exponent. Show ALL work!

(8) $7a^0b^3$ $7 \cdot 1 \cdot b^3 = \boxed{7b^3}$	(9) $\frac{6^8}{6^9} = 6^{-1} = \frac{1}{6}$	(10) $8x^{-2}$ $\frac{8}{x^2}$
(11) $10x^{-4}y^5$	(12) $\frac{8x^9}{2x}$	(13) $\left(\frac{3}{4}\right)^{-1}$ $\frac{4}{3}$
(14) $(4x^{-2}y^5z^{-3})(5x^3y^{-5}z^{-2})$	(15) $2^2(2^4 + 2^{-8})$	(16) $-x^3y^{-6}$

Determine the missing (?) value in each:

(17) $\frac{x^6}{x^?} = x^4$

(18) $\frac{2^8}{2^?} = 2^9$

Lesson Summary:

- Anything raised to the zero power is always _____.

- When you have negative exponents, in order to make them positive you:

HW # _____   *Date:_____*

Aim: How can we create a rule for exponents that are zero and negative?

Simplify each expression. Write solution without zero or negative exponents.

1. -3^0	**2.** $8k^0$	**3.** $(-5)^{-2}$
4. 2^{-4}	**5.** $5x^{-4}$	**6.** $\dfrac{x^5}{y^{-3}}$
7. $\dfrac{a^{-4}}{b^{-3}}$	**8.** $2x^{-1}y^{-4}$	**9.** $\dfrac{x^2}{2y^{-3}}$

10.   Which of the following is correct? *Explain* why the other choice is incorrect.

   a. $2x^{-3} = \dfrac{1}{2x^3}$ b. $2x^{-3} = \dfrac{2}{x^3}$

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