8th Grade Math: ExPWN it! 5

Key

Negative Exponents

Friday, September $\frac{2^5}{2^4}$, 2016

AIMS:

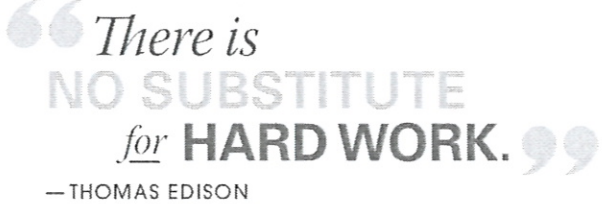
- ✓ SWBAT convert numbers raised to a negative exponent to equivalent fractional expressions.
- ✓ SWBAT simplify and write equivalent expressions that contain negative exponents.

AGENDA:

I. Do Now (2 min)
II. Open/Do Now Review (3 min)
III. Lesson Opener (5 min)
IV. Class Notes: Negative Exponents (5 min)
V. Guided Practice (5 min)
VI. You Try (5 min)
VII. Simplifying Expressions Guided Practice (5 min)
VIII. Independent Practice (10 min)
IX. Sprint (3 min)
X. Practicing our AIMS:
   - ✓ Exit Ticket (5 min)
   - ✓ Homework: ExPWN it! 5

XI. Close (2 min)

Will your choices help us STRIVE?



AIMS:

- ✓ SWBAT convert numbers raised to a negative exponent to equivalent fractional expressions.
- ✓ SWBAT simplify and write equivalent expressions that contain negative exponents.

AIM CHECK:

- ✓ When there is a negative exponent in the denominator of an expression, how can you simplify the expression?

- ✓ Do the other exponential rules we have already learned still apply to negative exponents?

8th Grade Math Negative Exponents	Name: Key #: Date: Homeroom: Cleveland State University KENTUCKY STATE UNIVERSITY	 ExPWN It! 5

AIM(S):

- ✓ SWBAT convert numbers raised to a negative exponent to equivalent fractional expressions.
- ✓ SWBAT simplify and write equivalent expressions that contain negative exponents.

DO NOW

Directions: Complete the following questions.

Directions: Simplify the following expressions.

$8 \cdot 3^0 \cdot 4 =$ $8 \cdot 1 \cdot 4 = 8 \cdot 4 = 32$

$x^0 \cdot y^0 \cdot z =$ $1 \cdot 1 \cdot z = z$

$\frac{5^3 \cdot 3^6}{3^6 \cdot 5^3} =$ $5^{3-3} \cdot 3^{6-6}$

$= 5^0 \cdot 3^0$

$= 1 \cdot 1$

$= 1$

$\left(\frac{128x^{75} \cdot 64y^{45}}{243z^{17}}\right)^0 =$ 1

Lesson opener: What does a negative power tell us to do?

So far, all of our powers have been positive integers. Today, we will explore a number raised to a negative integer.

Jerrick is trying to determine what a negative power means. He decides to look at a few problems with negative powers, that solve to have positive powers, to help him think about what they could possibly mean. Here are the problems he looks at:

$$5^7 \times 5^{-4} = 5^3$$

$$\frac{5^7}{5^{-4}} = 5^{11}$$

(STUCK? Jerrick also wrote the below two expressions on his paper!)

$$5^7 \times 5^4 = 5^{11}$$

$$\frac{5^7}{5^4} = 5^3$$

Think, pair, share: What does a negative integer exponent mean? Be prepared to explain how Jerrick's two equations show this.

Think	Pair	Share
		Example: $5^7 \times 5^{-4} = \frac{5^7}{5^4}$ So, $5^{-4} = \frac{1}{5^4}$ also, $5^7 \times 5^4 = \frac{5^7}{5^{-4}}$ So, $5^4 = \frac{1}{5^{-4}}$ the negative integer exponent means to invert the power, & make it positive.

Class Notes: Negative Exponents

Directions: Board Equals Paper!

Laws we Know

1. Multiplying same bases $x^m \cdot x^n = x^{m+n}$

2. Dividing same bases $\frac{x^m}{x^n} = x^{m-n}$

3. Power to a power $(x^m)^n = x^{m \cdot n}$ $(xy)^n = x^n y^n$

4. Power to the zeroth power $x^0 = 1$

Negative Exponents

So, what is x^n when n is a negative integer? Raising an exponent to a negative power means to divide by the base that many times, rather than Multiply!

Recall and Remember

You can always use concrete numbers for x, and *n* to explore this:

Example: Powers of 5		
	.. etc..	
5^2	1 × 5 × 5	25
5^1	1 × 5	5
5^0	1	1
5^{-1}	$1 \div 5 \rightsquigarrow \frac{1}{5}$	0.2
5^{-2}	$1 \div 5 \div 5 \rightsquigarrow \frac{1}{5^2}$	0.04
	.. etc..	

5x Larger

5x Smaller

Since fraction bars mean to divide, we can just place the exponential expression from the numerator over one, in to the denominator!

5. Power to the zeroth power $x^{-n} = \frac{1}{x^n}$

Definition: For any nonzero number x, and for any positive integer n, we define x^{-n} as $\frac{1}{x^n}$.

Note that this definition of negative exponents says x^{-1} is just the reciprocal, $\frac{1}{x}$, of x.

As a consequence of the definition, for a nonnegative x and all *integers* b, we get

$$x^{-b} = \frac{1}{x^b}.$$

Guided Practice

Directions: Board=Paper!

1) Simplify x^b the expression when $b = -3$

$x^{-3} = \frac{1}{x^3}$

For each question use the general statement $x^{-b} = \frac{1}{x^b}$ to verify each scenario.

1) Evaluate x^b when $x = 3$ and $b = -5$

$3^{-5} = \frac{1}{3^5}$ or $1 \div 3 \div 3 \div 3 \div 3 \div 3 = \frac{1}{243}$

81
÷ 3
243

2) Evaluate x^b when $x = 2$ and $b = -1$

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

You Try

1) Evaluate x^b when x = 5 and b = −4

$5^{-4} = \frac{1}{5^4} = \frac{1}{625}$

25
+28
125
500
625

2) Evaluate x^b when x = 1 and b = −7

$1^{-7} = \frac{1}{1^7} = \frac{1}{1} = 1$

3) Evaluate x^b when x = 10 and b = −3

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

Simplifying Expressions with Negative Exponents

What if the number is already being divided? For example, what is $\frac{1}{x^{-n}}$?

If the number is already being divided, we will instead multiply ! The quick step: Switch the location from the denominator to the numerator

Guided Practice

Directions: Board=Paper!

1) Write an equivalent expression, in exponential notation, to the one given, and simplify as much as possible.

a) $1234^{-7} =$ $\frac{1}{1234^7}$	b) $\frac{1}{385^7} =$ 385^{-7}
c) $12 \times 7^{-3} =$ $\frac{12}{7^3}$	d) $\frac{8^{97}}{8^{-5}} =$ $8^{97} \cdot 8^5 = 8^{102}$

Independent Practice

Directions: Complete every question below! Do your best! When done, you may work on the ADVANCED WORK ONLY (not homework ☺)

1) Write an equivalent expression, in exponential notation, to the one given, and simplify as much as possible.

a) $5^{-3} =$ $\frac{1}{5^3}$

b) $\frac{1}{8^9} =$ 8^{-9}

c) $3 \times 2^{-4} =$ $\frac{3}{2^4}$

d) Let x be a nonzero number. $x^{-3} =$ $\frac{1}{x^3}$

e) Let x be a nonzero number. $\frac{1}{x^9} =$ x^{-9}

f) Let x, y be two nonzero numbers. $xy^{-4} =$ $\frac{x}{y^4}$

g) $\frac{19^2}{19^5} =$ 19^{-3} or $\frac{1}{19^3}$

h) $\frac{17^6}{17^{-3}} =$ $17^6 \times 17^3 = 17^9$

2) Show directly that $\left(\frac{7}{5}\right)^{-4} = \frac{7^{-4}}{5^{-4}}$ example:

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

$= 1 \div 7 \div 7 \div 7 \div 7 \div \frac{1}{5} \div \frac{1}{5} \div \frac{1}{5} \div \frac{1}{5}$

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

8th Grade Math Advanced Work (Due 9/6/16)

Directions: Complete this for dollars! Turn in advanced work with your homework.

ame:_____ #:_____ HR:_____

1)

Tim is clearing brush from a large piece of land. The table shows how many acres he has cleared over time.

Brush Clearing

Acres Cleared	Days
$\frac{2}{3}$	2
$1\frac{2}{3}$	5
$2\frac{1}{3}$	7

How many days does it take Tim to clear 1 acre?

2)

Cary's barbecue sauce recipe calls for $2\frac{2}{3}$ cups of water for every 8 pints of tomato sauce.

How many cups of water does Cary use when she makes barbecue sauce with 1 pint of tomato sauce?

Name and Number: _____

ate: _____

Class: _____

Is this a re-submit?_____

HOMEWORK
8th Grade Math

ExPWN it! 5
Negative Exponents

Ms. Huber
614-859-0019
Mshubersmath.weebly.com

_____/ 5 = _____% DNG
A B C D F

STRIVE Due Date:	Accepted Until:
9/6/16	9/13/16

Directions: Complete all of the below problems (FRONT AND BACK). If you have questions, first check the examples in your packet. Then, check the class website or ask a classmate or guardian for help. Then, you can call your teacher if you still have questions.

1) Compute, showing expanded form:

$3^3 \times 3^2 \times 3^1 \times 3^0 \times 3^1 \times 3^{-2} =$

2) Compute, showing expanded form:

$3^3 \times 3^2 \times 3^1 \times 3^0 \times 3^{-1} \times 3^{-2} =$

3) Compute, showing expanded form, and assuming $a \neq 0$, :

$$a^m \times a^n \times a^l \times a^{-n} \times a^{-m} \times a^{-l} \times a^0 =$$

FLIP OVER!

Directions: Choose the correct answer choice for each question.

4) Evaluate x^b when x = 5 and b = −4

Ⓐ $\frac{1}{5^4}$

Ⓑ $\frac{1}{5^{-4}}$

Ⓒ $\frac{1}{20}$

Ⓓ -20

5) Evaluate x^b when x = 3 and b = −3

Ⓐ $\frac{1}{3^{-3}}$

Ⓑ $\frac{1}{-9}$

Ⓒ $\frac{1}{3^3}$

Ⓓ $\frac{3}{-3}$

6) What is the value of 5×10^{-3}

Ⓐ $\frac{5}{10^3}$

Ⓑ $\frac{1}{10^3}$

Ⓒ $\frac{10}{5^3}$

Ⓓ $\frac{1}{5^3}$

7) What is the value of 3×10^{-2}

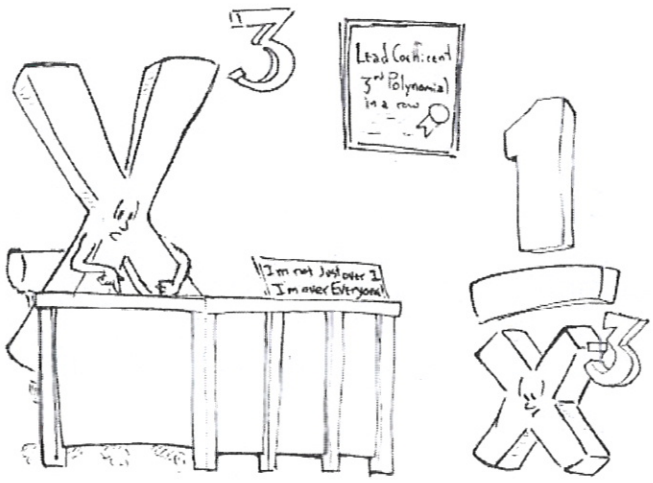
Ⓐ $\frac{3}{3^2}$

Ⓑ $\frac{10^2}{3}$

Ⓒ $\frac{1}{10^2}$

Ⓓ $\frac{3}{10^2}$

8) Read this comic, just for fun!



Mark my words! You harness that negative power of yours, and you can make it to the top just like me!

Name and Number: _____

Date: _____

Class: _____

Exit Ticket
8th Grade Math

ExPWN it! 5
Negative Exponents

Ms. Huber

_____/ 5 = _____% DNG

A B C D F

Directions: Complete all of the below problems. Do not use notes. This is an independent task, so you may not get help from your teacher either. Try your best! Work on Advanced work when done.

Write each expression in a simpler form that is equivalent to the given expression.

1) 76543^{-3}

2) Let f be a nonzero number. $f^{-4} =$

3) $671 \times 28796^{-1} =$

4) Let a, b be numbers $(b \neq 0)$. $ab^{-1} =$

5) Let g be a nonzero number. $\frac{1}{g^{-1}} =$

Reflect on your **understanding** of **TODAY'S LESSON**, and circle the most true statement			
I don't get it at all	I just need <u>some help</u>	I understand	I could teach it!
Reflect on your **effort** in **TODAY'S CLASS**, and circle the most true statement			
I wasn't working hard today	I was trying but off-task a little	I was on task	I was laser-focused on learning

SPRINT! (IF TIME!)

Directions: On a sprint, we practice our math facts for one minute. Then, we STOP, even if we're not done, so we can track our progress!

Directions: Simplify each expression using the laws of exponents. Use the least number of bases possible and only positive exponents. All letters denote numbers.

1.	$2^2 \cdot 2^3$	
2.	$2^2 \cdot 2^4$	
3.	$2^2 \cdot 2^5$	
4.	$3^7 \cdot 3^1$	
5.	$3^8 \cdot 3^1$	
6.	$3^9 \cdot 3^1$	
7.	$7^6 \cdot 7^2$	
8.	$7^6 \cdot 7^3$	
9.	$7^6 \cdot 7^4$	
10.	$11^{15} \cdot 11$	
11.	$11^{16} \cdot 11$	
12.	$2^{12} \cdot 2^2$	
13.	$2^{12} \cdot 2^4$	
14.	$2^{12} \cdot 2^6$	
15.	$99^5 \cdot 99^2$	
16.	$99^6 \cdot 99^3$	
17.	$99^7 \cdot 99^4$	
18.	$5^8 \cdot 5^2$	
19.	$6^8 \cdot 6^2$	
20.	$7^8 \cdot 7^2$	
21.	$r^8 \cdot r^2$	
22.	$s^8 \cdot s^2$	

23.	$6^3 \cdot 6^2$	
24.	$6^2 \cdot 6^3$	
25.	$(-8)^3 \cdot (-8)^7$	
26.	$(-8)^7 \cdot (-8)^3$	
27.	$(0.2)^3 \cdot (0.2)^7$	
28.	$(0.2)^7 \cdot (0.2)^3$	
29.	$(-2)^{12} \cdot (-2)^1$	
30.	$(-2.7)^{12} \cdot (-2.7)^1$	
31.	$1.1^6 \cdot 1.1^9$	
32.	$57^6 \cdot 57^9$	
33.	$x^6 \cdot x^9$	
34.	$2^7 \cdot 4$	
35.	$2^7 \cdot 4^2$	
36.	$2^7 \cdot 16$	
37.	$16 \cdot 4^3$	
38.	$3^2 \cdot 9$	
39.	$3^2 \cdot 27$	
40.	$3^2 \cdot 81$	
41.	$5^4 \cdot 25$	
42.	$5^4 \cdot 125$	
43.	$8 \cdot 2^9$	
44.	$16 \cdot 2^9$	