NAME: _____ DATE: _____

EXPONENTS PERIOD: _____

How Can You Simplify Expressions With Negative and Zero Exponents?

(Topic #3)

To understand what it means to have zero as an exponent, consider the following two methods of evaluating the quotient $\frac{3^5}{3^5}$.

Method 1 ***Method 2***

Zero as an Exponent
For any nonzero number a, $a^0 = 1$.

To understand what it means to have a negative exponent, consider the following two methods of evaluating the quotient $\frac{6^2}{6^4}$.

Method 1 ***Method 2***

Negative Exponent
For any integer n and any number a not equal to 0, a^{-n} is equal to 1 divided by a^n.

EXAMPLE 1: Evaluating Expressions

a) 3^{-4}

b) $(-8.5)^{-4} \cdot (-8.5)^{-4}$

c) $\frac{2^6}{2^8}$

PRACTICE! Evaluate the expression.

1. 4^{-2}	2. $(-2)^{-5}$	3. $6^{-8} \cdot 6^{8}$
4. $\frac{(-3)^5}{(-3)^6}$	5. $\frac{1}{5^{7}} \cdot \frac{1}{5^{-4}}$	6. $\frac{4^{3} \cdot 4^{-3}}{4^{2}}$

EXAMPLE 2: Simplifying Expressions

a) $-5x^{0}$

b) $\dfrac{9y^{-3}}{y^{5}}$

PRACTICE! Simplify. Write the expression using only positive exponents.

7. $8x^{-2}$	8. $b^{0} \cdot b^{-10}$	9. $\dfrac{z^{6}}{15z^{9}}$

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Homework #3

Evaluate the expression.

1. 29^0

2. 12^{-1}

3. $10^{-4} \cdot 10^{-6}$

4. $\frac{1}{3^{-3}} \cdot \frac{1}{3^5}$

Simplify. Write the expression using only positive exponents.

5. $19x^{-6}$

6. $\frac{14a^{-5}}{a^{-8}}$

7. $3t^6 \cdot 8t^{-6}$

8. $\frac{12s^{-1} \cdot 4^{-2} \cdot r^3}{s^2 \cdot r^5}$

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How Can You Simplify Expressions With Negative and Zero Exponents?

(Topic #3)

To understand what it means to have zero as an exponent, consider the following two methods of evaluating the quotient $\frac{3^5}{3^5}$.

***Method* 1** (Long Way!)

$$\frac{3^5}{3^5} = \frac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 3 \cdot 3} = \frac{1}{1} = 1$$

***Method* 2** (Applying rule previous learned)

$$\frac{3^5}{3^5} = 3^{5-5} = 3^0$$

$$1 = 3^0$$

Zero as an Exponent
For any nonzero number a, $a^0 = 1$.

To understand what it means to have a negative exponent, consider the following two methods of evaluating the quotient $\frac{6^2}{6^4}$.

***Method* 1** (Long Way!)

$$\frac{6^2}{6^4} = \frac{6 \cdot 6}{6 \cdot 6 \cdot 6 \cdot 6} = \frac{1}{6 \cdot 6} = \frac{1}{6^2}$$

***Method* 2** (Applying rule previous learned.)

$$\frac{6^2}{6^4} = 6^{2-4} = 6^{-2}$$

$$\frac{1}{6^2} = 6^{-2}$$

Negative Exponent
For any integer n and any number a not equal to 0, a^{-n} is equal to 1 divided by a^n.

EXAMPLE 1: Evaluating Expressions

a) $3^{-4} = \frac{1}{3^4} = \frac{1}{3 \cdot 3 \cdot 3 \cdot 3} = \frac{1}{81}$

b) $(-8.5)^{-4} \cdot (-8.5)^{-4} = (-8.5)^{-4+(-4)} = (-8.5)^{-8} = \frac{1}{(-8.5)^8} =$

$\frac{1}{27249052.8}$

c) $\frac{2^6}{2^8} = 2^{6-8} = 2^{-2} = \frac{1}{2^2} = \frac{1}{2 \cdot 2} = \frac{1}{4}$

PRACTICE! Evaluate the expression.

1. 4^{-2} $\frac{1}{4^2} = \frac{1}{4 \cdot 4} = \frac{1}{16}$	2. $(-2)^{-5}$ $\frac{1}{(-2)^5} = \frac{1}{(-2)(-2)(-2)(-2)(-2)}$ $\frac{-1}{32}$ OR $\frac{1}{-32}$ OR $-\frac{1}{32}$	3. $6^{-8} \cdot 6^{8}$ $6^{-8+8} = 6^0 = 1$
4. $\frac{(-3)^5}{(-3)^6}$ $(-3)^{5-6} = (-3)^{-1} = \frac{1}{(-3)^1} =$ $-\frac{1}{3}$	5. $\frac{1}{5^7} \cdot \frac{1}{5^{-4}}$ $\frac{1}{5^{7+(-4)}} = \frac{1}{5^3} =$ $\frac{1}{5 \cdot 5 \cdot 5} = \frac{1}{125}$	6. $\frac{4^5 \cdot 4^{-3}}{4^2} = \frac{4^2}{4^2} = 4^0 = 1$

EXAMPLE 2: Simplifying Expressions

a) $-5x^0 \longrightarrow -5 \cdot x^0$

$-5 \cdot 1$

-5

b) $\frac{9y^{-3}}{y^5} = 9 \cdot y^{-3-5} = 9 \cdot y^{-8} = 9 \cdot \frac{1}{y^8} = \frac{9}{y^8}$

PRACTICE! Simplify. Write the expression using only positive exponents.

7. $8x^{-2}$ $8 \cdot x^{-2}$ $8 \cdot \frac{1}{x^2} = \frac{8}{x^2}$	8. $b^0 \cdot b^{-10}$ $b^{0+(-10)} = b^{-10} = \frac{1}{b^{10}}$	9. $\frac{z^6}{15z^9} = \frac{1}{15} \cdot \frac{z^6}{z^9}$ $\frac{1}{15} \cdot z^{-3}$ $\frac{1}{15} \cdot \frac{1}{z^3}$ $\frac{1}{15z^3}$

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Homework #3

Evaluate the expression.

1. 29^0

1

2. 12^{-1}

$\frac{1}{12^1} = \frac{1}{12}$

3. $10^{-4} \cdot 10^{-6}$

$10^{-4+(-6)} = 10^{-10} = \frac{1}{10^{10}} = \frac{1}{10{,}000{,}000{,}000}$

4. $\frac{1}{3^{-3}} \cdot \frac{1}{3^5}$

$\frac{1}{3^{-3+5}} = \frac{1}{3^2} = \frac{1}{9}$

Simplify. Write the expression using only positive exponents.

5. $19x^{-6}$

$19 \cdot x^{-6}$

$19 \cdot \frac{1}{x^6}$

$\frac{19}{x^6}$

6. $\frac{14a^{-5}}{a^{-8}}$

$14 \cdot \frac{a^{-5}}{a^{-8}}$

$14 \cdot a^3 = 14a^3$

7. $3t^6 \cdot 8t^{-6}$

$3 \cdot 8 \cdot t^{6+(-6)}$

$24 \cdot t^0$

$24 \cdot 1$

24

8. $\frac{12s^{-1} \cdot 4^{-2} \cdot r^3}{s^2 \cdot r^5}$

$12 \cdot \frac{s^{-1}}{s^2} \cdot 4^{-2} \cdot \frac{r^3}{r^5}$

$12 \cdot s^{-3} \cdot 4^{-2} \cdot r^{-2}$

$\frac{12}{1} \cdot \frac{1}{s^3} \cdot \frac{1}{4^2} \cdot \frac{1}{r^2}$

$\frac{12}{16 s^3 r^2}$ OR $\frac{12}{16 r^2 s^3}$