

Content and Language Objective:

Students will explore the rules for using zero and negative exponents and apply them in the appropriate manner and explain how to use them in the appropriate manner.

Warm-Up

Write the number as an exponential expression, using the base shown.

1. 8 (base 2)

$$2^3$$

2. 1000 (base 10)

$$10^3$$

3. 256 (base 4)

$$4^4$$

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Exponents can be defined for any integer. Lets look at a few tables to see if we can find a pattern that is common.

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

$10^3 = 1000$	$\div 10$
$10^2 = 100$	$\div 10$
$10^1 = 10$	
$10^0 = 1$	
$10^{-1} = \frac{1}{10}$	
$10^{-2} = \frac{1}{100}$	
$10^{-3} = \frac{1}{1000}$	

$x^3 = x \bullet x \bullet x$
$x^2 = x \bullet x$
$x^1 = x$
$x^0 = 1$
$x^{-1} = \frac{1}{x}$
$x^{-2} = \frac{1}{x \bullet x}$
$x^{-3} = \frac{1}{x \bullet x \bullet x}$

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Exponent Rules to Live By!!!

$$0^0 = \text{undefined}$$

$$a^n = a \bullet a \bullet a \bullet a \cdots \bullet a$$

$$a^0 = 1$$

$$2^{-5} = \frac{1}{2^5} = \frac{1}{32}$$

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

or

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

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

$$\frac{a^{-n}}{b^{-m}} = \frac{b^m}{a^n}$$

$$\frac{2^{-3}}{4^{-3}} = \frac{4^3}{2^3} = \frac{64}{8} = 8$$

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$$

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

$$\left(\frac{5}{3}\right)^{-3} = \left(\frac{3}{5}\right)^3 = \frac{27}{125}$$

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PRACTICE:

$$\frac{2^{-2}}{(3t)^{-3}}$$
$$\frac{(3t)^3}{2^2}$$
$$\frac{27t^3}{4}$$

1. 3^{-4} $\frac{1}{3^4} = \frac{1}{81}$

2. $\frac{1}{2^{-3}}$ $\frac{2^3}{1} = 2^3 = 8$

3. $\left(\frac{5}{7}\right)^{-2}$ $\left(\frac{7}{5}\right)^2 = \frac{49}{25}$

4. $\frac{1}{(xy)^{-1}}$ $\frac{(xy)^1}{1} = xy$

5. $\frac{2^{-2}}{3t^{-3}}$

$$\frac{2^{-2}}{3t^{-3}} = \frac{2^{-2}}{3 \cdot t^{-3}}$$
$$= \frac{t^3}{3 \cdot 2^2}$$

$$= \frac{t^3}{3 \cdot 4}$$

$$= \frac{t^3}{12}$$

