

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) $2^3 = 8$

2. 1000 (base 10) 10^3

3. 256 (base 4) $4 \times 4 \times 4 \times 4$ or

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.

$$\frac{x}{x} = 1$$

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

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

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

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Exponent Rules to Live By!!!

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

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

$$a^0 = 1$$

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

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

or

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

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

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

$$\frac{2^{-4}}{3^{-2}} = \frac{3^2}{2^4} = \frac{9}{16}$$

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

$$\left(\frac{3}{4}\right)^{-3} = \left(\frac{4}{3}\right)^3 = \frac{64}{27}$$

$$\frac{2^3}{4^{-2}} = 2^3 \cdot 4^2 = 8 \cdot 16 = 128$$

$$\frac{5^{-2}}{3^2} = \frac{1}{3^2 \cdot 5^2} = \frac{1}{9 \cdot 25} = \frac{1}{225}$$

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PRACTICE:

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

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

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

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

$\frac{49}{25}$

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

xy

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

$\frac{3^3}{2^2} = \frac{27}{4} = 6$

