

## 4.5

## Negative Exponents and Reciprocals

$$x^a \cdot x^b = x^{a+b}$$

$$\frac{x^a}{x^b} = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

$$\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}$$

$$x^0 = 1$$

$$x^{\frac{a}{b}} = \left(x^{\frac{1}{b}}\right)^a$$

$$\text{or } \left(x^a\right)^{\frac{1}{b}}$$

## Lesson 6

## Connect

## Negative Exponents

## Powers with Negative Exponents

When  $x$  is any non-zero number and  $n$  is a rational number,  $x^{-n}$  is the reciprocal of  $x^n$ .

That is,  $x^{-n} = \frac{1}{x^n}$  and  $\frac{1}{x^{-n}} = x^n$ ,  $x \neq 0$

$$\frac{1}{4} \div 2$$

$$\frac{1}{4} \cdot \frac{1}{2} = \frac{1}{8} \quad \frac{1}{2^3}$$

$$\frac{1}{2} \div 2$$

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

Show Examples:

$$2^3 = 8$$

$$2^2 = 4 \quad \left. \begin{array}{l} 2^3 = 8 \\ 2^2 = 4 \end{array} \right\} \div 2$$

$$2^1 = 2$$

$$\leftarrow 2^0 = 1$$

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

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

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

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

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

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## Connect

## Evaluate each Power

Example 1:

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

$$= \frac{1}{9}$$

STEPS:

Remember the negative in the exponent means the positive reciprocal.

Then evaluate

## Connect

## Evaluate each Power

Example 2:

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

$$= \frac{1}{125}$$

STEPS:

Remember the negative in the exponent means the positive reciprocal.

Then evaluate

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Connect	Evaluate each Power
<p><b>Example 3:</b></p> $\left(-\frac{3}{4}\right)^{-3} = \left(\frac{-4}{3}\right)^3$ $= \frac{(-4)^3}{3^3}$ $= \frac{-64}{27}$	<p><b>STEPS:</b></p> <p>Remember the negative in the exponent means the positive reciprocal.</p> <p>Then evaluate</p>

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Connect	Evaluate each Power
<p><b>Example 4:</b></p> $0.3^{-4} = \left(\frac{3}{10}\right)^{-4} = \left(\frac{10}{3}\right)^4$ $= \frac{10^4}{3^4}$ $= \frac{10000}{81}$	<p><b>STEPS:</b></p> <p>Use a calculator to evaluate</p>

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Connect	YOU TRY!			
$7^{-2}$ $= \frac{1}{7^2}$ $= \frac{1}{49}$	$6^{-4}$ $= \frac{1}{6^4}$ $= \frac{1}{1296}$	$\left(\frac{10}{3}\right)^{-3}$ $= \left(\frac{3}{10}\right)^3$ $= \frac{27}{1000}$	$(1.5)^{-2}$ $= \left(\frac{3}{2}\right)^{-2}$ $= \left(\frac{2}{3}\right)^2$ $= \frac{4}{9}$	

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Connect	Evaluate each Power
<p><b>Example 5:</b></p> $8^{-\frac{2}{3}} = \frac{1}{8^{\frac{2}{3}}}$ $= \frac{1}{(\sqrt[3]{8})^2}$ $= \frac{1}{2^2}$ $= \frac{1}{4}$	<p><b>STEPS:</b></p> <p>Write with a positive exponent</p> <p>Take the cube root</p> <p>Square the result</p>

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Example 5:

$$\begin{aligned}\left(\frac{9}{16}\right)^{\frac{3}{2}} &= \left(\frac{16}{9}\right)^{\frac{3}{2}} \\ &= \left(\sqrt{\frac{16}{9}}\right)^3 \\ &= \left(\frac{\sqrt{16}}{\sqrt{9}}\right)^3 \\ &= \left(\frac{4}{3}\right)^3 \\ &= \frac{64}{27}\end{aligned}$$

STEPS:

Write with a positive exponent

Take the square root

Cube the result

Textbook Questions:

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