Warm Up:

1. Evaluate each of the following without using a calculator:

$(a)\ 27^{\frac{1}{3}} = ?$

$(b)\ 64^{\frac{3}{2}} = ?$

$(c)\left(\frac{32}{128}\right)^{\frac{3}{4}} = ?$

$(d)\ (0.027)^{\frac{2}{3}} = ?$

2. Evaluate each of the following using a calculator:

$(a)\ -32^{\frac{2}{7}} = ?$

$(b)\ 20^{\frac{5}{8}} = ?$

$-(3\times3)$

$-3^2 = -9$

$(-3)^2 = 9$

$(-3)\times(-3) = 9$

4.5 Negative Exponents and Reciprocals

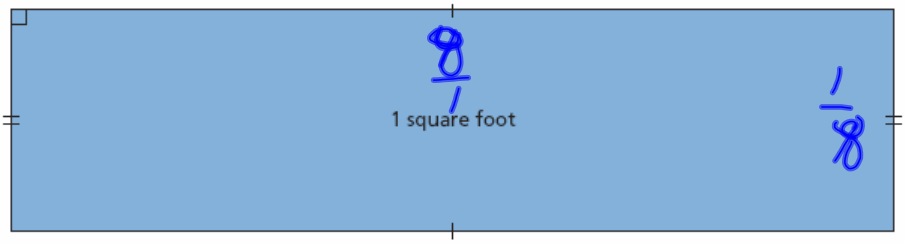
LESSON FOCUS Relate negative exponents to reciprocals.

Make Connections

$\frac{2}{3}\cdot\frac{3}{2} = \frac{6}{6} = 1$

$A = 4\cdot\frac{1}{4} = 1$

A rectangle has area 1 square foot.
List 5 possible pairs of lengths and widths for this rectangle.
What is the relationship between the possible lengths and widths?



6^{-2}

$= -36$

Reciprocals:

What are some properties of numbers classified as reciprocals?

* $\frac{a}{b} \cdot \frac{b}{a} = 1$

Definition:

Two numbers with a product of 1 are reciprocals.

Since $4 \cdot \frac{1}{4} = 1$, the numbers 4 and $\frac{1}{4}$ are reciprocals.

Similarly, $\frac{2}{3} \cdot \frac{3}{2} = 1$, so the numbers $\frac{2}{3}$ and $\frac{3}{2}$ are also reciprocals.

Use the concept of reciprocals to deal with NEGATIVE exponents...

We define powers with negative exponents so that previously developed properties such as $a^m \cdot a^n = a^{m+n}$ and $a^0 = 1$ still apply.

$2^3 \cdot \text{Reciprocal} = 1$

$2^3 \cdot \text{Rec} = 2^0$

$2^3 \cdot 2^{-3} = 2^0$

$8 \cdot \frac{1}{8} = 1$

$7^5 \xrightarrow{\text{Rec}} 7^{-5}$

$7^{-5} \Rightarrow$

How can we explain the meaning of negative exponents?

$$5^{-3} = ?$$

$$5^{-3} = \frac{1}{5^3} = \frac{1}{125}$$

IMPORTANT PROPERTY!!

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

Examples:

$6^{-2} = \frac{1}{6^2} = \frac{1}{36}$

Switch all negative exponents to positives

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

$\left(\frac{5}{2}\right)^3 = \frac{5^3}{2^3} = \frac{125}{8}$

$\frac{3^{-2}}{4} = \frac{1}{3^2 \cdot 4} = \frac{1}{36}$

$0.2^{-4} = \left(\frac{2}{10}\right)^{-4} = \left(\frac{10}{2}\right)^4 = 5^4 = 625$

$= \frac{10000}{16}$

How about NEGATIVE RATIONAL exponents?

$\left(\frac{9}{16}\right)^{-\frac{3}{2}} = \left(\frac{16}{9}\right)^{\frac{3}{2}}$ Write with a positive exponent.

$= \left(\sqrt{\frac{16}{9}}\right)^3$ Take the square root.

$= \left(\frac{4}{3}\right)^3$ Cube the result.

$= \frac{64}{27}$

Evaluate the following:

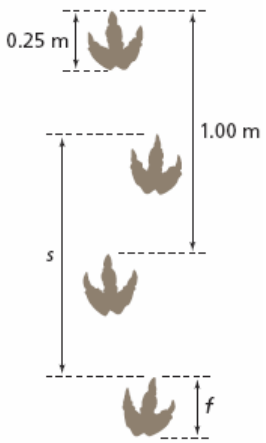
$9^{-\frac{3}{2}} = \frac{1}{9^{3/2}} = \frac{1}{27}$

$\left(\frac{8}{27}\right)^{-\frac{4}{3}} = \left(\frac{27}{8}\right)^{4/3} = \frac{81}{16}$

$=$

Example 3 Applying Negative Exponents

Paleontologists use measurements from fossilized dinosaur tracks and the formula $v = 0.155 s^{\frac{5}{3}} f^{-\frac{7}{6}}$ to estimate the speed at which the dinosaur travelled. In the formula, v is the speed in metres per second, s is the distance between successive footprints of the same foot, and f is the foot length in metres. Use the measurements in the diagram to estimate the speed of the dinosaur.



SOLUTION

Practice Problems...

Page 233 - 234
#6, 7, 8, 9, 11, 12, 13, 14, 16, 17

Attachments

Worksheet - Levels of Differences.doc

Worksheet Solns - Levels of Differences.doc