

## Warm Up:

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

$$(a) 27^{\frac{1}{3}} = ? \quad \left( \sqrt[3]{27} \right)^1 = 3$$

$$(b) 64^{\frac{3}{2}} = ? \quad \left( \sqrt{64} \right)^3 = 8^3 = 512$$

$$(c) \left( \frac{16}{81} \right)^{\frac{3}{4}} = ? \quad \left( \sqrt[4]{\frac{16}{81}} \right)^3 = \left( \frac{2}{3} \right)^3 = \frac{8}{27}$$

$$(d) 32^{\frac{7}{5}} = ? \quad \left( \sqrt[5]{32} \right)^7 = 2^7 = 128$$

2. Evaluate each of the following using a calculator:

$$(a) -32^{\frac{2}{7}} = ? \quad \left( \sqrt[7]{-32} \right)^2 = 2.69 \dots$$

$$(b) 20^{\frac{5}{8}} = ? \quad \left( \sqrt[8]{20} \right)^5 = 6.503 \dots$$

## Practice Problems...

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#3, 5, 6, 7, 8, 10, 11, 12, 15, 16

for  
homework

## 4.5 Negative Exponents and Reciprocals



### LESSON FOCUS

Relate negative exponents to reciprocals.

Reciprocals:

$$\frac{1}{2} \times \frac{2}{1} = \frac{2}{2} = 1$$

What are some properties of numbers classified as reciprocals?

**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.

How can we explain the meaning of negative exponents?

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

$$5^{-3} \cdot 5^3 = 5^{-3+3} = 5^0 = 1$$

## IMPORTANT PROPERTY!!

## Powers with Negative Exponents

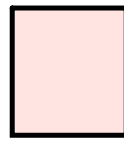
When  $x$  is any non-zero number and  $n$  is a rational number,  $x^{-n}$  is the reciprocal of  $x^n$ .

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

Examples:

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

$$\left(\frac{2}{5}\right)^{-3} = \left(\frac{5}{2}\right)^3 = \frac{125}{8} = 15.625$$



$$\frac{1}{0.2^4} = \frac{1}{0.0016}$$

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

$$5^4 = 625$$

How about NEGATIVE RATIONAL exponents?

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

Write with a positive exponent.

(flip base)

Take the square root.

Cube the result.

Evaluate the following:

$$\begin{aligned} 9^{-\frac{3}{2}} &= \frac{1}{9^{\frac{3}{2}}} \\ &= \frac{1}{\left(\sqrt{9}\right)^3} \\ &= \frac{1}{27} \end{aligned}$$

$$\begin{aligned} \left(\frac{8}{27}\right)^{\frac{4}{3}} &= \left(\frac{27}{8}\right)^{\frac{4}{3}} \\ &= \left(\frac{\sqrt[3]{27}}{\sqrt[3]{8}}\right)^4 \\ &= \left(\frac{3}{2}\right)^4 \end{aligned}$$

$$\frac{81}{16} = 5\frac{1}{16}$$

**Practice Problems...**

1 Pg. 227 10, 11, 12, 15, 14

Page 233 - 234: #3 - 10, 16

## Attachments

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Image (19).jpg

4.1 Page 206 Questions.pdf

Worksheet - Simplifying Radicals (Square Roots).pdf

Review - Laws of Exponents.pdf

Review - Laws of Exponents (Grade 9).pdf

Review Solutions - Laws of Exponents (Grade 9).pdf

Warm Up - Laws of Exponents.pdf

Assignment - Radicals and Exponent Laws Feb. 2014.pdf