5-Negative Exponents

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1.5 POWERS WITH NEGATIVE RATIONAL EXPONENTS

Name:

Blk: ___

Recall: $x^{\frac{m}{n}} = \sqrt[n]{x^m} = \left(\sqrt[n]{x}\right)^m$ and $x^{-m} = \left(\frac{1}{x}\right)^m$ or $\frac{1}{x^m}$ where $\frac{1}{x}$ is the **reciprocal** of x

- Two numbers are <u>reciprocal S</u> when their **product** is equal to $\frac{1}{4}$.

Powers with a Negative Integer Exponent and a Rational Base:

$$\left(\frac{a}{b}\right)^{-m} = \left(\frac{b}{a}\right)^{m}$$
, where a and b are integers; $a \neq 0, b \neq 0$

Example 1: Evaluate each power

a)
$$8^{-2}$$

b)
$$(-2)^{-4}$$

c)
$$(0.3)^{-3}$$

d)
$$\left(\frac{18}{15}\right)^{-2}$$

$$= \frac{10}{3}$$

$$= \frac{1000}{27}$$

$$= \left(\frac{5}{6}\right)^2$$

$$= \left(\frac{5}{6}\right)^2$$

Powers with Negative Rational Exponents:

$$\frac{m}{n} = \frac{1}{\sqrt[n]{r^m}} \quad O$$

 $x^{-\frac{m}{n}} = \frac{1}{\sqrt[n]{x^m}}$ OR $x^{-\frac{m}{n}} = \frac{1}{(\sqrt[n]{x})^m}$, where x is a non-zero integer, and m and n

are natural numbers; for even values of m and n, $m \neq n$ if a < 0.

Example 2: Evaluate each power after writing it as a radical.

a)
$$(-8)^{-\frac{2}{3}}$$

$$= \left(\frac{1}{-8}\right)^{\frac{2}{3}}$$

b)
$$100^{-2.5}$$
 $= 100^{-5/2}$ $= (\frac{1}{2})^{5/2}$

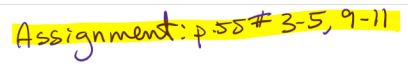


d)
$$-81^{-4}$$

$$= \left(\frac{1}{\sqrt{181}}\right)^{3}$$

$$= \left(\frac{1}{\sqrt{3}}\right)^{3}$$

$$= \begin{bmatrix} 33 \\ 3^3 \end{bmatrix}$$
$$= \begin{bmatrix} 27 \\ 27 \end{bmatrix}$$



Powers with Negative Rational Exponents and Rational Bases:

$$\left(\frac{a}{b}\right)^{-\frac{m}{n}} = \sqrt[n]{\left(\frac{b}{a}\right)^m}$$
 OR $\left(\frac{a}{b}\right)^{-\frac{m}{n}} = \left(\sqrt[n]{\left(\frac{b}{a}\right)}\right)^m$, where $\frac{a}{b}$ is a rational number, and $a \neq 0, b \neq 0$, and m and n are natural numbers.

· Basically we are working with all fractions now!

Example 3: Evaluate each power after writing it as a radical

a)
$$\left(\frac{1}{8}\right)^{-\frac{2}{3}}$$
 b) $\left(\frac{100}{9}\right)^{-\frac{3}{2}}$ c) $\left(\frac{324}{64}\right)^{-\frac{3}{4}}$

Example 4: Application to a word problem

Use the formula $C(t) = A(2)^{-\frac{t}{5}}$ to determine how much caffeine remains in the body after 12 hours when the initial mass of caffeine ingested is 75mg. Give your answer to 1 decimal place.