Date: Apr. 5/19

Today's Learning Goal(s):

By the end of the class, I will be able to:

a) evaluate a power involving a rational exponent.
b) simplify expressions involving rational exponents.

Last day's work: **READ p.221**

pp. 221-223 #(1 – 9)ace, 11b, 13acegi, 16ace

p.222 **9.** Evaluate. Express answers in rational form.

K a) $(-4)^{-3}$ c) $-(5)^{-3}$ e) $(-6)^{-3}$

b) $(-4)^{-2}$ d) $-(5)^{-2}$ f) $-(6)^{-2}$

c) $-(5)^{-3}$

$= -\left(\frac{1}{5^3}\right)$

$= -\left(\frac{1}{125}\right)$

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

p.222 **11.** Evaluate each expression for $x = -2$, $y = 3$, and $n = -1$.

b) $(x^2)^n(y^{-2n})x^{-n}$

$= x^{2n}y^{-2n}x^{-n}$

$= x^{2n+(-n)}y^{-2n}$

$= x^n y^{-2n}$ or $= (xy^{-2})^n$

$= (-2)^{-1}(3)^{-2(-1)}$

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

$= \frac{1}{-2}(9)$

$= \frac{-9}{2}$

p.223 **13.** Evaluate using the laws of exponents.

e) $\frac{2^5}{3^{-2}} \times \frac{3^{-1}}{2^4}$

$= 2^{5-4} \times 3^{-1-(-2)}$

$= 2^1 \cdot 3^1$

$= 6$

g) $\frac{3^{-2} \times 2^{-3}}{3^{-1} \times 2^{-2}}$

$= 3^{-2-(-1)} \cdot 2^{-3-(-2)}$

$= 3^{-2+1} \cdot 2^{-3+2}$

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

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

$= \frac{1}{6}$

i) $\frac{5^{-1} - 2^{-2}}{5^{-1} + 2^{-2}}$

$= \frac{\left(\frac{1}{5}\right)^1 - \left(\frac{1}{2}\right)^2}{\frac{1}{5^1} + \frac{1}{2^2}}$

$= \frac{\frac{1}{5} - \frac{1}{4}}{\frac{1}{5} + \frac{1}{4}}$

$= \left(\frac{4}{20} - \frac{5}{20}\right) \div \left(\frac{4}{20} + \frac{5}{20}\right)$

$= \frac{-1}{20} \div \left(\frac{9}{20}\right)$

$= \frac{-1}{\cancel{20}} \times \frac{\cancel{20}}{9}$

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

p.223 **16.** Determine the exponent that makes each equation true.

a) $16^x = \frac{1}{16}$

$16^x = 16^{-1}$

$\therefore x = -1$

c) $2^x = 1$

$2^x = 2^0$

$x = 0$

e) $25^n = \frac{1}{625}$

$25^n = \frac{1}{25^2}$

$25^n = 25^{-2}$

$n = -2$

4.3 Working with Rational Exponents

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Rational Exponents are exponents that are **fractions**, and are directly related to radicals.

$4^{\frac{1}{2}}$ is the same as $\sqrt[2]{4}$

$8^{\frac{1}{3}}$
$= \sqrt[3]{8}$
$= 2$

$81^{\frac{3}{4}}$
$= (\sqrt[4]{81})^3$
$= (3)^3$
$= 27$

$\rightarrow (81^{\frac{1}{4}})^3$ or $(81^3)^{\frac{1}{4}}$
$= \sqrt[4]{81^3}$
$= \sqrt[4]{531441}$
$= 27$

$81^{-\frac{3}{4}}$
$= \left(\frac{1}{81}\right)^{\frac{3}{4}}$
$= \frac{1}{(\sqrt[4]{81})^3}$
$= \frac{1}{(3)^3}$
$= \frac{1}{27}$

In general:

$$\therefore b^{\frac{1}{n}} = \sqrt[n]{b} \qquad \therefore b^{\frac{m}{n}} = \left(\sqrt[n]{b}\right)^m$$

Ex.1 Write in radical form, then evaluate *without* using a calculator.

a) $36^{\frac{1}{2}}$
$= \sqrt{36}$
$= 6$

b) $27^{-\frac{1}{3}}$
$= \left(\frac{1}{27}\right)^{\frac{1}{3}}$
$= \frac{1}{\sqrt[3]{27}}$
$= \frac{1}{3}$

c) $8^{-\frac{2}{3}}$
$= \left(\frac{1}{8}\right)^{\frac{2}{3}}$
$= \frac{1}{(\sqrt[3]{8})^2}$
$= \frac{1}{2^2}$
$= \frac{1}{4}$

d) $16^{\frac{3}{4}}$
$= (\sqrt[4]{16})^3$
$= 2^3$
$= 8$

Ex.2 Write each root as a power with a rational exponent.

a) $\sqrt[3]{27}$
$= 27^{\frac{1}{3}}$

b) $\left(\sqrt[4]{16}\right)^3$
$= 16^{\frac{3}{4}}$

c) $\left(\sqrt[3]{81}\right)^{-2}$
$= 81^{-\frac{2}{3}}$ or $= \frac{1}{81^{\frac{2}{3}}}$

Ex.3 Write as a single power, *do not evaluate*.

a) $\frac{\sqrt{16}}{\sqrt{2}}$

$= \sqrt{\frac{16}{2}}$
$= \sqrt{8}$
$= 8^{\frac{1}{2}}$

or
$= \frac{16^{\frac{1}{2}}}{2^{\frac{1}{2}}}$
$= \left(\frac{16}{2}\right)^{\frac{1}{2}}$
$= 8^{\frac{1}{2}}$

$\rightarrow$ or
$\rightarrow \frac{(2^4)^{\frac{1}{2}}}{2^{\frac{1}{2}}}$
$= \frac{2^2}{2^{\frac{1}{2}}}$
$= 2^{2-\frac{1}{2}}$
$= 2^{\frac{4}{2}-\frac{1}{2}}$
$= 2^{\frac{3}{2}}$
$= 2$

b) $\frac{\sqrt{8}}{\sqrt{4}}$

$= \sqrt{\frac{8}{4}}$
$= \sqrt{2}$
$= 2^{\frac{1}{2}}$

or $= \frac{8^{\frac{1}{2}}}{4^{\frac{1}{2}}}$
$= \left(\frac{8}{4}\right)^{\frac{1}{2}}$
$= 2^{\frac{1}{2}}$

Worth remembering:

$1^2=1$	$1^3=1$	$1^4=1$
$2^2=4$	$2^3=8$	$2^4=16$
$3^2=9$	$3^3=27$	$3^4=81$
$4^2=16$	$4^3=64$	$4^4=256$
$5^2=25$	$5^3=125$	$5^4=625$
$10^2=100$	$10^3=1000$	$10^4=10\,000$

Ex.4 Evaluate, *without* using a calculator.

a) $81^{\frac{1}{4}}$

$= \sqrt[4]{81}$

$= 3$

b) $(-8)^{\frac{1}{3}}$

$= \sqrt[3]{-8}$

$= -2$

c) $64^{-\frac{1}{2}}$

$= \dfrac{1}{64^{\frac{1}{2}}}$

$= \dfrac{1}{\sqrt{64}}$

$= \dfrac{1}{8}$

d) $(-100\,000)^{-\frac{1}{5}}$

$= \left(\dfrac{1}{-100\,000}\right)^{\frac{1}{5}}$

$= \dfrac{1}{\sqrt[5]{-100\,000}}$

$= \dfrac{1}{-10}$

e) $8^{\frac{2}{3}}$

$= \left(\sqrt[3]{8}\right)^2$

$= 2^2$

$= 4$

f) $16^{-0.75}$

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

$= \dfrac{1}{16^{\frac{3}{4}}}$

$= \dfrac{1}{\left(\sqrt[4]{16}\right)^3}$

$= \dfrac{1}{2^3}$

$= \dfrac{1}{8}$

g) $\dfrac{\left(16^{\frac{7}{8}}\right)\left(16^{-\frac{1}{4}}\right)}{16^{\frac{1}{8}}}$

$= 16^{\frac{7}{8}+\left(-\frac{1}{4}\right)-\frac{1}{8}}$

$= 16^{\frac{7}{8}-\frac{2}{8}-\frac{1}{8}}$

$= 16^{\frac{4}{8}}$

$= 16^{\frac{1}{2}}$

$= \sqrt{16}$

$= 4$

Are there any Homework Questions you would like to see on the board?

Last day's work: **READ p.221**

pp. 221-223 #(1 – 9)ace, 11b, 13acegi, 16ace

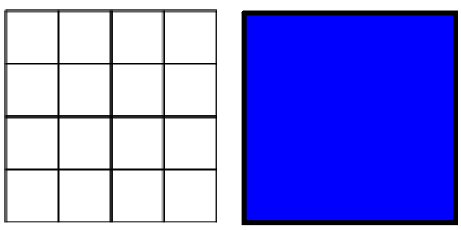
READ p.228

Today's Homework Practice includes:

pp. 229-230 #(1 – 6)ace, 8 – 11, 12ace, 14 [16]

Also:

The area of the square is 16 units^2



The volume of the cube is 64 units^3.