

Date: Oct. 23/19

## Today's Learning Goal(s):

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

- evaluate a power involving a rational exponent.
- simplify expressions involving rational exponents.

Are there any questions from last day's assigned work you would like to see on the board?

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

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

6, 7, 8

p.221 8. Determine the exponent that makes each equation true.

- |                |                             |
|----------------|-----------------------------|
| a) $9^x = 81$  | c) $(-5)^a = -125$          |
| b) $8^m = 256$ | d) $-10^r = -100\,000\,000$ |

$$(2^3)^m = 2^8$$

$$2^{3m} = 2^8$$

$$\therefore 3m = 8$$

$$m = \frac{8}{3}$$

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

- |                         |                |                |
|-------------------------|----------------|----------------|
| <b>K</b> a) $(-4)^{-3}$ | c) $-(5)^{-3}$ | e) $(-6)^{-3}$ |
| b) $(-4)^{-2}$          | d) $-(5)^{-2}$ | f) $-(6)^{-2}$ |

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

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

p.222 6. Simplify, then evaluate each expression. Express answers in rational form.

a)  $10(10^4(10^{-2}))$

c)  $\frac{6^{-5}}{(6^2)^{-2}}$

e)  $2^8 \times \left(\frac{2^{-5}}{2^6}\right)$

b)  $8(8^2)(8^{-4})$   
 $= 8^{1+2+(-4)}$

$$= 8^{-1}$$

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

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

d)  $\frac{4^{-10}}{(4^{-4})^3}$

f)  $13^{-5} \times \left(\frac{13^2}{13^8}\right)^{-1}$

$$= 13^{-5} \times (13^{2-8})^{-1}$$

$$= 13^{-5} \times (13^{-6})^{-1}$$

$$= 13^{-5} \times 13^{(-6)(-1)}$$

$$= 13^{-5} \times 13^6$$

$$= 13^{-5+6}$$

$$= 13^1$$

$$= 13$$

p.222 7. Evaluate. Express answers in rational form.

a)  $16^{-1} - 2^{-2}$

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

b)  $(-3)^{-1} + 4^0 - 6^{-1}$

e)  $5^{-3} + 10^{-3} - 8(1000^{-1})$

c)  $\left(-\frac{2}{3}\right)^{-1} + \left(\frac{2}{5}\right)^{-1}$

f)  $3^{-2} - 6^{-2} + \frac{3}{2}(-9)^{-1}$

$$= 16^{-1} - 2^{-2}$$

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

$$= \frac{1}{16} - \frac{1}{4}$$

$$= \frac{1}{16} - \frac{4}{16}$$

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

$$= \frac{1}{5^3} + \frac{1}{10^3} - 8\left(\frac{1}{1000}\right)$$

$$= \frac{1}{125} + \frac{1}{1000} - \frac{8}{1000}$$

$$= \frac{8}{1000} + \frac{1}{1000} - \frac{8}{1000}$$

$$= \frac{1}{1000}$$

p.222 13. Evaluate using the laws of exponents.

$$\begin{aligned} \text{a) } 2^3 \times 4^{-2} \div 2^2 & \\ &= 2^3 \times (2^2)^{-2} \div 2^2 \\ &= 2^3 \times 2^{-4} \div 2^2 \\ &= 2^{3+(-4)-2} \\ &= 2^{-3} \\ &= \frac{1}{2^3} \\ &= \frac{1}{8} \end{aligned}$$

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

p.222

16. Determine the exponent that makes each equation true.

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

$$\text{c) } 2^x = 1$$

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

$$2^x = 2^0$$

$$\therefore x = 0$$

## 4.3 Working with Rational Exponents

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

$$4^{\frac{1}{2}} \text{ is the same as } \sqrt[2]{4} \quad \left(\frac{1}{81}\right)^{\frac{2}{4}} \quad \frac{10^3}{81^{\frac{3}{4}}}$$

$$8^{\frac{1}{3}} \quad 81^{\frac{3}{4}} \quad 81^{-\frac{3}{4}}$$

$$= \sqrt[3]{8} \quad = (81^{\frac{1}{4}})^3 \text{ or } (81^{\frac{3}{4}})^1 \quad = \frac{1}{81^{\frac{3}{4}}}$$

$$= 2 \quad = (\sqrt[4]{81})^3 \quad = (\sqrt[4]{531441})^1 \quad = \frac{1}{(\sqrt[4]{81})^3}$$

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

$$\quad = 27 \quad = 27$$

In general:

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

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

$$\begin{array}{llll} \text{a) } 36^{\frac{1}{2}} & \text{b) } 27^{-\frac{1}{3}} & \text{c) } 8^{-\frac{2}{3}} & \text{d) } 16^{\frac{3}{4}} \\ = \sqrt{36} & = \frac{1}{27^{\frac{1}{3}}} & = \frac{1}{8^{\frac{2}{3}}} & = (\sqrt[4]{16})^3 \\ = 6 & = \frac{1}{\sqrt[3]{27}} & = \frac{1}{(\sqrt[3]{8})^2} & = 2^3 \\ & = \frac{1}{3} & = \frac{1}{2^2} & = 8 \\ & & = \frac{1}{4} & \end{array}$$

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

$$\begin{array}{lll} \text{a) } \sqrt[3]{27} & \text{b) } (\sqrt[4]{16})^3 & \text{c) } (\sqrt[3]{81})^{-2} \\ = 27^{\frac{1}{3}} & = 16^{\frac{3}{4}} & = 81^{-\frac{2}{3}} \\ & & = \frac{1}{81^{\frac{2}{3}}} \end{array}$$

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

$$\begin{array}{ll} \text{a) } \frac{\sqrt{16}}{\sqrt{2}} & \text{b) } \frac{\sqrt{8}}{\sqrt{4}} \rightarrow \sqrt{\frac{8}{4}} \\ = 16^{\frac{1}{2}} \div 2^{\frac{1}{2}} & = 8^{\frac{1}{2}} \div 4^{\frac{1}{2}} \\ = (2^{\frac{4}{1}})^{\frac{1}{2}} \div 2^{\frac{1}{2}} & = (2^3)^{\frac{1}{2}} \div (2^2)^{\frac{1}{2}} \\ = 2^2 \div 2^{\frac{1}{2}} & = 2^{\frac{3}{2}} \div 2^1 \\ = 2^{2-\frac{1}{2}} & = 2^{\frac{3}{2}-1} \\ = 2^{\frac{3}{2}} & = 2^{\frac{1}{2}} \end{array}$$

Worth remembering:

$1^2 = 1$	$1^3 = 1$	$1^4 = 1$
$2^2 = 4$	$2^3 = 8$	$2^4 = 16$
$3^2 = 9$	$3^3 = 27$	$3^4 = 81$
$4^2 = 16$	$4^3 = 64$	$4^4 = 256$
$5^2 = 25$	$5^3 = 125$	$5^4 = 625$
$10^2 = 100$	$10^3 = 1000$	$10^4 = 10000$

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

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

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

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

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

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

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

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

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

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

$$= 2^2$$

$$= 4$$

f)  $16^{-0.75}$

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

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

$$= \frac{1}{(\sqrt[4]{16})^3}$$

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

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

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

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

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

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

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

$$= \sqrt{16}$$

$$= 4$$

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

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

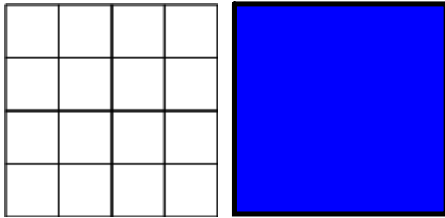
**READ p.228**

Today's Assigned Practice includes:

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

**Also:**

The area of the square is 16 units<sup>2</sup>



The volume of the cube is 64 units<sup>3</sup>.

