

*Law #7a: Negative Reciprocals***NEW**

$$x^{-n} = \frac{1}{x^n}$$

remember the reciprocal of

$$\frac{1}{2} \text{ is } 2$$

so

 $2^{-1}$  is the reciprocal of  $2^1$ **Examples:**

$$\begin{aligned} \frac{6^{-2}}{1} &= \left( \frac{1}{6} \right)^2 \\ &= \frac{1^2}{6^2} \\ &= \frac{1}{6^2} \\ &= \frac{1}{36} \end{aligned}$$

*Law #7b: Negative Reciprocals*

NEW

$$\frac{1}{x^{-n}} = \frac{1}{\frac{1}{x^n}} = x^n$$

Examples:

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

Change position

**Law #7c: Negative Reciprocal Quotient**      **NEW**

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$$

Flip fraction and exponent is now positive

Examples:

$$\left(\frac{3}{4}\right)^{-3} = \left(\frac{4}{3}\right)^3$$

$$\left(\frac{7}{1}\right)^{-2}$$

$$\left(\frac{1}{7}\right)^2$$

$$\frac{1}{7^2}$$

$$\frac{1}{49}$$

- 1)  $18v^9u^6$
- 2)  $16y^5$
- 3)  $8x^8y^2$
- 4)  $16y^{20}x^{12}$
- 5)  $3n^3m^2$
- 6)  $v^4u^4$
- 7)  $b^{10}$

$$8) a^5$$

$$9) n^{10}m^2$$

$$10) 4x^4y^5$$

$$\begin{aligned}
 & 9) \left( \frac{m^2 n^2 \cdot m^3 n^2}{m^4 n^{-1}} \right)^2 \\
 & \left( \frac{m^5 n^4}{m^4 n^{-1}} \right)^2 \\
 & \left( m^1 n^{4-(-1)} \right)^2 \\
 & \left( m n^5 \right)^2 \\
 & m^2 n^{10}
 \end{aligned}$$

$$\begin{aligned}
 & 8) \frac{(a^{-2} b^3)^{-1} \cdot 2a^4 b^3}{2a} \\
 & = \frac{a^2 b^{-3} \cdot 2a^4 b^3}{2a} \\
 & = \frac{2a^6 b^0}{2a} \\
 & = a^5
 \end{aligned}$$

$$\frac{a a a a a a}{a}$$

$$10) \frac{x^4 y^{-2}}{(2y^4)^2 \cdot y x^0}$$

$$= \frac{x^4 y^{-2}}{2^{-2} y^8 y x^0}$$

$$= \frac{x^4 y^{-2}}{2^{-2} y^{-1} x^0}$$

$$y^{-2-1}$$

$$\frac{x^4 y^5}{2^{-2}}$$

$$2^2 x^4 y^5$$

$$4 x^4 y^5$$

$$3^{-2} x^4$$

$$\frac{x^4}{3^2}$$

$$\frac{x^4}{9}$$

$$-2^{-2}$$

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

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

$$6) \frac{4^1 u^4 v^2}{4^1 v^{-2}}$$

$$2 \begin{array}{l} 0 \\ | \\ 4^1 v^2 \end{array} \begin{array}{l} \uparrow \uparrow \\ \text{odd odd} \end{array} \begin{array}{l} -2 \\ \uparrow \uparrow \\ \text{odd odd} \end{array}$$

$$1 \cdot 4^4 v^4$$

$$\left( \frac{b^2 \cdot b}{b^{-2}} \right)^2$$

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

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

$$= (b^5)^2$$

$$b^{10}$$

} quotient law says to subtract exponent of like bases

power to power

$$2x^2 \cdot (2^2 y^2 x^3)^2$$

power to power multiply ex

$$2x^2 \cdot 2^4 y^4 x^6$$

multiply like bases so add ex

$$\begin{array}{ccc} 2^3 & x^8 & y^4 \\ \hline 8 & x^8 & y^4 \end{array}$$

$$4) \quad y^4 \cdot (2x^3y^4)^4$$

power to power

$$2^4 x^{12} y^{16}$$

$$2^4 y^{20} x^{12}$$

$$16 y^{20} x^{12}$$

$$5) \quad \frac{3m^{-1}n^2}{m^{-3}n^{-1}}$$

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

add opp

$$3m^{-1+3} n^{2+1}$$

$$3m^2 n^3$$

### Example 1

### Evaluating Powers with Negative Integer Exponents

Evaluate each power.

a)  $3^{-2}$       b)  $\left(-\frac{3}{4}\right)^{-3}$       c)  $0.3^{-4}$

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

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

$$\begin{aligned} & \left(\frac{10}{3}\right)^4 \\ & \frac{10^4}{3^4} \\ & \frac{10000}{81} \end{aligned}$$

$$\frac{0.3}{1} \left( \frac{3}{10} \right)$$

$$\mathbf{b)} \left(-\frac{3}{4}\right)^{-3}$$

Evaluate each power without using a calculator.

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

b)  $\left(\frac{9}{16}\right)^{-\frac{3}{2}}$

**SOLUTION**

a)  $8^{-\frac{2}{3}} = \left(\frac{1}{8}\right)^{\frac{2}{3}}$  Write with a positive exponent

*exponent* (pointing to 2/3)  
*index* (pointing to 3)

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

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

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

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

$= \frac{1}{4}$

exponent  
index

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

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

# Homework

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#3a,b,c,d

#4a,c

#6a,b,c

#7a,b,c,

#9a,c,e,g

#10a,c

#12

#13a,b,d,e

1) Express each of a radical and evaluate

$$a) 64^{\frac{2}{3}} = (\sqrt[3]{64})^2$$

$$(4)^2$$

2) Express as a power don't evaluate

$$(\sqrt[5]{216})^5 = 216^{\frac{5}{5}}$$

3) Entire  $\rightarrow$  Mixed

$$\sqrt{192} = \sqrt{81 \times 2} = 9\sqrt{2}$$

4) Write each with positive exponent

$$a) 7^{-3} = \frac{1}{7^3}$$

5) Exponent laws

$$(5x^{-2}y^3)^2$$

$$5^2 x^{-4} y^6$$

$$\frac{25y^6}{x^4}$$

Quiz Wednesday

Unit 4 Probably

Mar 2 Test

Write the reciprocal for each:

a)  $7^{-3}$

b)  $242$

c)  $\frac{1}{6}$

d)  $8^2$

Simplify the following (Leave your answer with positive exponents):

a)  $(3xy^{-2})^4$

b) 
$$\frac{(12r^6t^3)}{(3r^{10}t^2)}$$

What is the value of  $\left(\frac{a^6b^9}{a^5b^8}\right)^{-2}$  when  $a = -3$  and  $b = 2$ ?

$$\mathbf{b)} \left[ \left( -\frac{3}{2} \right)^{-4} \right]^2 \cdot \left[ \left( -\frac{3}{2} \right)^2 \right]^3$$

