

**Objectives:**

- I can simplify expressions with rational exponents.

**Vocabulary:** Exponent Rules

<p>Product of Powers:  <math>x^a \cdot x^b = x^{a+b}</math></p> <p><b>Numerical Example:</b>  <math>(8^{1/2})(8^{1/2}) = 8^{1/2+1/2}</math>  <math>8^{2/2} = 8</math></p>	<p>Quotient of Powers:  <math>\frac{x^a}{x^b} = x^{a-b}</math></p> <p><b>Numerical Example:</b>  <math>\frac{7^{3/2}}{7^{1/2}} = 7^{3/2-1/2} = 7^{2/2} = \boxed{7}</math></p>	<p>Negative Exponents:  <math>x^{-a} = \frac{1}{x^a}</math></p> <p><b>Numerical Example:</b>  <math>9^{-1/2} = \frac{1}{9^{1/2}}</math></p>
<p>Power of a Power:  <math>(x^a)^b = x^{a \cdot b}</math></p> <p><b>Numerical Example:</b>  <math>(5^{1/2})^4 = 5^{4/2} = 5^2 = \boxed{25}</math></p>	<p>Zero Exponents:  <math>x^0 = 1</math></p> <p><b>Numerical Example:</b>  <math>(6^{-7/8})^0 = 6^0 = 1</math></p>	<p>Powers of a Quotient:  <math>\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}</math></p> <p><b>Numerical Example:</b>  <math>\left(\frac{5}{27}\right)^{1/3} = \frac{5^{1/3}}{27^{1/3}}</math></p>

**Example Set:** Simplify each expression. Your answers should only include positive exponents.

1.  $x \cdot x^{1/2}$

$x^{1+1/2}$   
 $x^{2/2+1/2}$   
 $x^{3/2}$

2.  $(p^{-1})^{-1/2}$

$\left(\frac{1}{p}\right)^{-1/2}$   
 $\frac{1^{-1/2}}{p^{-1/2}} = \frac{p^{1/2}}{1^{1/2}}$   
 $\frac{p^{1/2}}{1} = \boxed{p^{1/2}}$

3.  $2x \cdot 4x^{-1/2}$

$2 \cdot 4 \cdot x \cdot x^{-1/2}$   
 $8x^{1+(-1/2)}$   
 $\boxed{8x^{1/2}}$

4.  $3v^{3/4} \cdot 2v^{1/4}$

$3 \cdot 2 \cdot v^{3/4+1/4}$   
 $6v^{3/4+1/4}$   
 $\boxed{6v}$

5.  $\frac{3m^{-1/2}}{2m^{7/4}}$

$\frac{3}{2m^{7/4}m^{1/2}}$   
 $m^{7/4+1/2}$   
 $\frac{7}{4} + \frac{2}{4} = \frac{9}{4}$   
 $\boxed{\frac{3}{2m^{9/4}}}$

6.  $\frac{2p^{4/3}}{p^{2/3}}$

$2p^{4/3-2/3}$   
 $\boxed{2p^{2/3}}$

$$7. \frac{x^{\frac{3}{4}}}{x^{-\frac{3}{2}}}$$

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

$$x^{\frac{3}{4} + \frac{3}{2}} = x^{\frac{6}{4}}$$

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

$$8. \frac{(n^2)^{\frac{1}{2}}}{n \cdot n}$$

$$n^{\frac{1}{2} \cdot \frac{1}{2}}$$

$$\frac{n^{\frac{1}{4}}}{n^2}$$

$$n^{\frac{1}{4} - 2} = n^{\frac{8}{4}}$$

$$n^{-\frac{7}{4}}$$

$$\boxed{\frac{1}{n^{\frac{7}{4}}}}$$

$$9. \frac{(x^2)^2}{x^{\frac{1}{2}} x^{\frac{3}{2}}}$$

$$x^{\frac{3}{2} \cdot 2} = x^{\frac{6}{2}} = x^3$$

$$x^{\frac{1}{2} + \frac{3}{2}} = x^{\frac{4}{2}} = x^2$$

$$\frac{x^3}{x^2} = \boxed{x}$$

## Properties of Rational Exponents

Note: You have already learned and used all of these properties.

Product of Powers:  $a^m \cdot a^n = a^{m+n}$

Power of a Power:  $(a^m)^n = a^{m \cdot n}$

Power of a Product:  $(ab)^m = a^m b^m$

Negative Exponent:  $a^{-m} = \frac{1}{a^m}, a \neq 0$

Zero Exponent:  $a^0 = 1, a \neq 0$

Quotient of Powers:  $\frac{a^m}{a^n} = a^{m-n}, a \neq 0$

Power of a Quotient:  $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}, b \neq 0$