Lesson 5-7B: Rational Exponents

$\frac{1}{b^{1/2}} \cdot \frac{b^{1}}{b^{1}}$

True or False: $a^{x} \cdot a^{-x} = a^{0} = 1$

All the properties of powers you learned in Lesson 5-1 apply to rational exponents. When simplifying expressions containing rational exponents, leave the exponent in rational form rather than writing the expression as a radical. To simplify such an expression, you must write the expression with all positive exponents. Furthermore, any exponents in the denominator of a fraction must be positive integers. So, it may be necessary to rationalize the denominator.

Examples:

1. Simplify

a. $\frac{1}{3^{\frac{1}{2}}} \cdot \frac{3^{\frac{1}{2}}}{3^{\frac{1}{2}}} = \frac{3^{\frac{1}{2}}}{3}$ $\qquad \frac{1}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{3}$

b. $\frac{1}{4^{\frac{1}{3}}} \cdot \frac{4^{2/3}}{4^{2/3}} = \frac{4^{2/3}}{4^{1}}$

c. $\frac{3}{r^{\frac{2}{3}}} \cdot \frac{r^{1/3}}{r^{1/3}} = \frac{3r^{1/3}}{r}$

Conditions for Simplified Expressions

An expression is simplified when it meets these conditions.

1. **It has no** negative **exponents.**
2. **It has no fractional exponents in the denominator.**
3. **It is not a complex fraction.**
4. **The index of any remaining radical is as small as possible.**

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2. Simplify

a. $r^{-\frac{1}{9}} = \frac{1}{r^{1/9}} \cdot \frac{r^{\frac{8}{9}}}{r^{\frac{8}{9}}}$

$= \boxed{\frac{r^{8/9}}{r}}$

b. $p^{-\frac{2}{5}} = \frac{1}{p^{2/5}} \cdot \frac{p^{\frac{3}{5}}}{p^{3/5}}$

$= \frac{p^{3/5}}{p}$

c. $35 \cdot 7^{-\frac{2}{3}}$

$$\frac{35}{7^{2/3}} \cdot \frac{7^{\frac{1}{3}}}{7^{\frac{1}{3}}}$$

$$\frac{35 \cdot 7^{\frac{1}{3}}}{7} = 5 \cdot 7^{\frac{1}{3}}$$

d. $\dfrac{\left(a^{\frac{1}{2}} - b^{\frac{1}{2}}\right)}{\left(a^{\frac{1}{2}} + b^{\frac{1}{2}}\right)} \cdot \dfrac{\left(a^{\frac{1}{2}} - b^{\frac{1}{2}}\right)}{\left(a^{\frac{1}{2}} - b^{\frac{1}{2}}\right)}$

$$\frac{a - a^{\frac{1}{2}}b^{\frac{1}{2}} - a^{\frac{1}{2}}b^{\frac{1}{2}} + b}{a - b}$$

$$\frac{a - 2a^{\frac{1}{2}}b^{\frac{1}{2}} + b}{a - b}$$

e. $\dfrac{a^{\frac{1}{2}}+b^{\frac{1}{2}}}{a^{\frac{3}{2}}-b^{\frac{3}{2}}} \cdot \dfrac{a^{\frac{3}{2}}+b^{\frac{3}{2}}}{a^{\frac{3}{2}}+b^{3/2}}$

f. $\dfrac{(xy)^{\frac{1}{2}}+y^{\frac{1}{2}}}{y^{\frac{1}{2}}} \cdot \dfrac{y^{\frac{1}{2}}}{y^{\frac{1}{2}}}$

$$\frac{a^2+a^{\frac{1}{2}}b^{\frac{3}{2}}+a^{\frac{3}{2}}b^{\frac{1}{2}}+b^2}{a^3-b^3}$$

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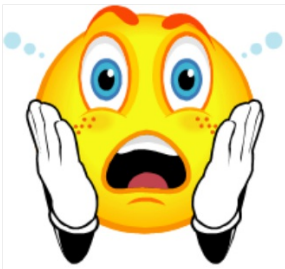

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