Unit 5: Radical Expressions Name: key

Secondary 3H: 5-1 Notes: Multiplying and Dividing Radicals

Exponent Rules

- $x^a * x^b = x^{a+b}$
- $x^{-a} = \frac{1}{x^a}$
- $x^0 = 1$
- $\frac{x^a}{x^b} = x^{a-b}$
- $(x^a)^b = x^{ab}$

Find the following roots:

- $\sqrt{81} < 9 = 9$
- $\sqrt[3]{-64} = -4$
- $\sqrt[4]{16} = 2$
- $\sqrt[3]{\frac{1}{27}} = \frac{1}{3}$

Simplify the following:

- $\sqrt{9b^2} = 3b$
- $\sqrt{a^8b^{18}} = a^4b^9$
- $\sqrt[3]{-125a^3} = -5a$
- $\sqrt[4]{16x^{16}y^{20}} = 2x^4y^5$

Write a radical that simplifies to be the following:

- $4a^2b\sqrt[3]{cd^2}$

$\sqrt{64a^6b^3cd^2}$

- $3x^2y^4\sqrt{20x^3z^2}$

$= \sqrt{81x^8y^4 20x^3z^2}$

$= \sqrt{1620x^{11}y^4z^2}$

Radical Expressions

- Definition of a radical:

an expression with a root.

- Label the parts of the given radical:

index, radical, radicand: $\sqrt[n]{x}$

- Where are they used in real life?

Area
~~Geometry~~
2 variables

Multiplying Radical Expressions

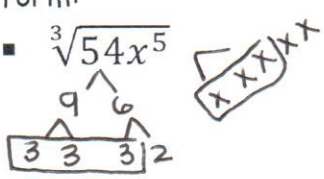
- If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, then $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$.

Can you simplify the product of the rational expressions? Explain.

- $\sqrt{2} * \sqrt[3]{6}$ NO. Not same index.
- $\sqrt[3]{-4} * \sqrt[3]{2} = \sqrt[3]{(-4)(2)} = \sqrt[3]{-8} = -2$
- $\sqrt[4]{7} * \sqrt[5]{7}$ NO. Not same index.
- $\sqrt[3]{4} * \sqrt[3]{16} = \sqrt[3]{(4)(16)} = \sqrt[3]{64} = 4$
- $\sqrt[3]{-12} * \sqrt[3]{-18} = \sqrt[3]{(-12)(-18)} = \sqrt[3]{216} = 6$

Writing in Simplest Form

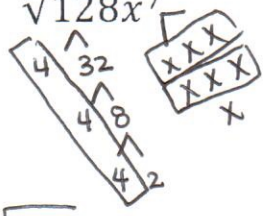
- When we simplify, we are reducing the radical as much as possible:
- Write the following radical expression in simplest form:
  - $\sqrt[3]{54x^5}$



$= 3x\sqrt[3]{2x^2}$

Your Turn

- Write the following in simplest form:
  - $\sqrt[3]{128x^7}$

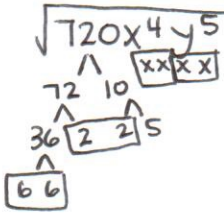


$= 4x^2\sqrt[3]{2x}$

Simplifying a Product

- In order to simplify a product, we multiply the radicands first, then simply as much as possible:
- Write the following product in simplest form:
  - $\sqrt{72x^3y^2} * \sqrt{10xy^3}$

$\sqrt{720x^4y^5}$ $= 12x^2y^2\sqrt{5y}$



Your Turn

- Write the following product in simplest form:
  - $\sqrt{45x^5y^3} * \sqrt{35xy^4}$

$= \sqrt{1575x^6y^7}$

$= 15x^3y^3\sqrt{7y}$

  - $-\sqrt[3]{2x^2y^2} * 2\sqrt[3]{15x^5y}$

$= -2\sqrt[3]{30x^7y^3}$

$= -2x^2y\sqrt[3]{30x}$

Do we really have it?

- The base of a triangle is $\sqrt{18}\ cm$ and its height is $\sqrt{8}\ cm$. Find its area.

$A = \frac{1}{2}bh$

$= \frac{1}{2}(\sqrt{18})(\sqrt{8}) = \frac{1}{2}\sqrt{144} = \frac{1}{2}(12) = 6\ cm^2$

- **Dividing Radical Expressions**
  - If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers and $b \neq 0$, then $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$

- **What is the simplest form of the quotient?**
  - $\frac{\sqrt{18x^5}}{\sqrt{2x^3}} = \sqrt{\frac{18x^5}{2x^3}} = \sqrt{9x^2}$
    $= \boxed{3x}$
  - $\frac{\sqrt[3]{162y^5}}{\sqrt[3]{3y^2}} = \sqrt[3]{\frac{162y^5}{3y^2}}$
    $= \sqrt[3]{54y^3} = \boxed{3y\sqrt[3]{2}}$

Your Turn

- $\frac{\sqrt{48x^3}}{\sqrt{3xy^2}} = \sqrt{\frac{48x^3}{3xy^2}} = \sqrt{\frac{16x^2}{y^2}}$
  $= \boxed{\frac{4x}{y} \text{ OR } 4xy^{-1}}$
- $\frac{\sqrt{20ab}}{\sqrt{45a^2b^3}} = \sqrt{\frac{20ab}{45a^2b^3}}$
  $= \sqrt{\frac{4}{9ab^2}} = \boxed{\frac{2}{3b\sqrt{a}}}$

Rationalizing the Denominator

- With this method you rewrite the expression so that there are no radicals in any denominator and no denominator in any radical!
  - $\frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{(\sqrt{2})^2} = \boxed{\frac{\sqrt{2}}{2}}$

Let's Try Another

- What is the simplest form of
  - $\sqrt{\frac{12ab^3c^2}{10a^3bc}} = \sqrt{\frac{12b^2c}{10a^2}}$
    $= \sqrt{\frac{6b^2c}{5a^2}} = \frac{b}{a}\sqrt{\frac{6c}{5}} = \frac{b}{a}\frac{\sqrt{6c}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}}$
    $= \boxed{\frac{b\sqrt{30c}}{5a}}$

The formula $F = \frac{mv^2}{r}$ gives the centripetal force F of an object of mass m moving along a circle of radius r, where v is the tangential velocity of the object. Solve the formula for v. Rationalize the denominator.

$$F = \frac{mv^2}{r}$$
$$Fr = mv^2$$
$$\frac{Fr}{m} = v^2$$
$$v = \sqrt{\frac{Fr}{m}} = \frac{\sqrt{Fr}}{\sqrt{m}} \cdot \frac{\sqrt{m}}{\sqrt{m}} = \boxed{\frac{\sqrt{Frm}}{m} = v}$$