6-2 MULTIPLYING AND DIVIDING RADICAL EXPRESSIONS

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COMBINING RADICAL EXPRESSIONS: PRODUCTS

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

- You can simplify the product of radicals if they have the same index

Can you simplify the product of these radical expressions?

A) $\sqrt[4]{7} \cdot \sqrt[5]{7}$

No; the indexes are different.

B) $\sqrt[5]{-5} \cdot \sqrt[5]{-2}$

$\sqrt[5]{-5 \cdot -2} \quad = \sqrt[5]{10}$

SIMPLIFYING A RADICAL EXPRESSION

If the radicand of $\sqrt[n]{a}$ has a perfect *nth* power among its factors, you can *reduce* the radical. Always put the radical in *simplest form*.

- Simplify until all *nth* roots are taken (find factors of radicand)

$$\sqrt{24} = \sqrt{4 \cdot 6} = \sqrt{2^2 \cdot 6} = 2\sqrt{6}$$

How do we know we are done simplifying?

- When the radicand has no more perfect square factors

$$\sqrt[3]{24x^5y^6} = \sqrt[3]{8 \cdot 3 \cdot x \cdot x \cdot x \cdot x \cdot x \cdot y \cdot y \cdot y \cdot y \cdot y \cdot y} = \sqrt[3]{2^3 \cdot 3x^3x^2y^3y^3} = 2xy^2\sqrt[3]{3x^2}$$

How do we know we are done simplifying?

- When the radicand has no more perfect cube factors

SIMPLIFYING A PRODUCT

Assume all variables are positive

Combine using multiplication then simplify

- Remember that the **index** must be the same

What is the simplest form of $\sqrt{45x^5y^3} \cdot \sqrt{35xy^4}$?

$$\sqrt{45x^5y^3} \cdot \sqrt{35xy^4} = \sqrt{9 \cdot 5 \cdot x^5 \cdot y^3} \cdot \sqrt{7 \cdot 5 \cdot x \cdot y^4}$$

$$= \sqrt{9 \cdot 7 \cdot 5 \cdot 5 \cdot x^5 \cdot x \cdot y^4 \cdot y^3}$$

$$= \sqrt{9 \cdot 7 \cdot 5 \cdot 5 \cdot x^6 \cdot y^7}$$

$$= 3 \cdot 5x^3y^3 \cdot \sqrt{7y} = 15x^3y^3\sqrt{7y}$$

TRY THESE

What is the simplest form of:

A) $\sqrt[3]{135x^5}$

$\sqrt[3]{27\cdot 5\cdot x^3x^2}$

$3x\sqrt[3]{5x^2}$

B) $\sqrt{48x^5y^2}\cdot\sqrt{50x^2y^4}$

$\sqrt{16\cdot 3\cdot x^4\cdot x\cdot y^2}\cdot\sqrt{25\cdot 2\cdot x^2\cdot y^4}$

$\sqrt{16\cdot 25\cdot 3\cdot 2\cdot x^4\cdot x^2\cdot x\cdot y^2\cdot y^4}$

$4\cdot 5\cdot x^2\cdot x\cdot y\cdot y^2\sqrt{3\cdot 2\cdot x}$

$\left|20x^3y^3\right|\sqrt{6x}$

$20x^3\left|y^3\right|\sqrt{6x}$

COMBINING RADICAL EXPRESSIONS: QUOTIENTS

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

You can simplify the quotients of radicals if they have the **same index**

What is the simplest form of $\frac{\sqrt[3]{189x^7}}{\sqrt[3]{7x^2}}$?

$\sqrt[3]{\frac{189x^7}{7x^2}}$

$=\sqrt[3]{27x^5}$

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

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

COMBINING RADICAL EXPRESSIONS: QUOTIENTS

Another way to simplify a radical expression is to **rationalize the denominator.** This means re-writing the expression so that there aren't any radicals in the denominator

Simplify $\frac{\sqrt[3]{7x}}{\sqrt[3]{5y^2}}$

Multiply by 1

$$\frac{\sqrt[3]{7x}}{\sqrt[3]{5y^2}} \cdot \frac{\sqrt[3]{5^2 y}}{\sqrt[3]{5^2 y}} = \frac{\sqrt[3]{7x \cdot 5^2 y}}{5y} = \frac{\sqrt[3]{175xy}}{5y}$$

How do we know what to multiply by? We need to make each factor of the radicand in the denominator perfect cube factors

TRY THESE

What is the simplest form of:

A) $\sqrt[3]{\frac{4x^4}{32yz^3}} = \frac{\sqrt[3]{x^4}}{\sqrt[3]{8yz^3}}$

$$\frac{\sqrt[3]{x^4}}{\sqrt[3]{8yz^3}} \cdot \frac{\sqrt[3]{y^2}}{\sqrt[3]{y^2}} = \frac{\sqrt[3]{x^4 y^2}}{\sqrt[3]{8y^3 z^3}}$$

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

B) $\frac{\sqrt{50x^6}}{\sqrt{2x^4}} = \sqrt{\frac{50x^6}{2x^4}}$

$$\sqrt{\frac{50x^6}{2x^4}} = \sqrt{25x^2}$$

$$= 5|x|$$