Simplifying Higher Roots with Variables

$$\sqrt[n]{a^m} = a^{m/n} = a^{\frac{power}{root}}$$

$$\sqrt[4]{m^8} = m^{8/4} = m^2$$

$$\sqrt[4]{a^{20}} = a^{20/4} = a^5$$

TRY:

$\sqrt{y^{36}}$ $\sqrt{m^8}$

$\sqrt[4]{x^4}$ $\sqrt[5]{x^{30}}$

What if the root is not a factor of the power as in $\sqrt[4]{a^{11}}$?

Rewrite the radical using the Product Rules: $\sqrt[n]{ab}$ = $\sqrt[n]{a} \cdot \sqrt[n]{b}$ and $a^m a^n = a^{m+n}$

$$\sqrt[4]{a^{11}} = \sqrt[4]{a^{8+3}} = \sqrt[4]{a^8} \cdot \sqrt[4]{a^3} = a^{8/4} \cdot \sqrt[4]{a^3} = a^2 \sqrt[4]{a^3}$$

Another way of thinking.

To simplify a radical completely, think about how many times the index goes into the exponent of the radicand with how many left over. For example, to simplify $\sqrt[4]{a^{11}}$, ask how many times 4 goes into 11?

Answer: 2 times with 3 left over.

$$\sqrt[4]{a^{11}} = \sqrt[4]{a^{8+3}} = \sqrt[4]{a^8} \cdot \sqrt[4]{a^3} = a^2 \sqrt[4]{a^3}$$

The '2' exponent comes out and the '3' leftover stays in.

Or one can think of it as: $\sqrt[4]{a^{11}} = a^{\frac{11}{4}} = a^{2\frac{3}{4}} = a^2 \sqrt[4]{a^3}$

TRY:

$\sqrt[3]{x^8}$ $\sqrt[4]{x^{19}}$ $\sqrt[5]{x^{18}}$

The process works with radicands including integers and variables:

$\sqrt[4]{64x^9}$ = $\sqrt[4]{16}\cdot\sqrt[4]{4}\cdot\sqrt[4]{x^8}\cdot\sqrt[4]{x} = 2x^2\sqrt[4]{4x}$

TRY:

$\sqrt[3]{27z^2}$ $\sqrt[3]{5b^9}$

$\sqrt[3]{270x^5}$ $\sqrt[4]{20000x^7}$

$\sqrt[4]{162b^4}$ $\sqrt[5]{96a^8}$ $\sqrt[3]{48x^3y^8z^7}$