3-1 Radicals

3-1a: I can simplify radical expressions.

3-1b: I can convert between radical and exponential form.

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Definition
nth root

$$\sqrt[n]{b} = a \quad \text{means} \quad b = a^n$$

In $\sqrt[n]{b}$:

The symbol $\sqrt{\ }$ is called the radical

n is called the index

b is called the radicand

if there is no written index, an index of 2 is implied

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Know your powers and roots

Perfect Squares:	Square Roots:	Perfect Cubes:	Cube Roots:
$1^2 = 1$	$\sqrt{1} = 1$	$1^3 = 1$	$\sqrt[3]{1} = 1$
$2^2 = 4$	$\sqrt{4} = 2$	$2^3 = 8$	$\sqrt[3]{8} = 2$
$3^2 = 9$	$\sqrt{9} = 3$	$3^3 = 27$	$\sqrt[3]{27} = 3$
$4^2 = 16$	$\sqrt{16} = 4$	$4^3 = 64$	$\sqrt[3]{64} = 4$
$5^2 = 25$	$\sqrt{25} = 5$	$5^3 = 125$	$\sqrt[3]{125} = 5$

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Evaluate

$\sqrt{9}$

3

$\sqrt[3]{64}$

4

$\sqrt[4]{16}$ 2

$\sqrt[3]{-8}$

$-\sqrt[3]{8}$

-2

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Simplify

$\sqrt{18} \rightarrow \sqrt{3^2} \cdot \sqrt{2}$ $\boxed{3\sqrt{2}}$

$9 \quad 2$
$3 \quad 3$
$\sqrt{3^2 \cdot 2}$

$\sqrt{48}$ $\sqrt{2^2} \cdot \sqrt{2^2} \cdot \sqrt{3}$

$24 \quad 2$ $2 \cdot 2 \cdot \sqrt{3}$
$12 \quad 2$ $\boxed{4\sqrt{3}}$
$6 \quad 2$
$3 \quad 2$

$5\sqrt[3]{24}$

$4 \quad 6$
$2 \quad 2 \quad 2 \quad 3$

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

$5 \cdot 2 \cdot \sqrt[3]{3}$

$\boxed{10\sqrt[3]{3}}$

$\sqrt[4]{32}$ $\sqrt[4]{2^4} \cdot \sqrt[4]{2}$

$8 \quad 4$
$4 \quad 2 \quad 2 \quad 2$
$2 \quad 2$ $\boxed{2\sqrt[4]{2}}$

Simplify

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

$\sqrt{x^6}$ $\sqrt[3]{x^{12}}$ x^4
$(x \cdot x)(x \cdot x)(x \cdot x)$ $(x \cdot x \cdot x)(x \cdot x \cdot x)$
$\sqrt{x^2} \cdot \sqrt{x^2} \cdot \sqrt{x^2}$ $(x \cdot x \cdot x)(x \cdot x \cdot x)$
$x \cdot x \cdot x$
x^3

Simplify.

$\sqrt{20x^{10}}$ $(x \cdot x)(x \cdot x)(x \cdot x)(x \cdot x)(x \cdot x)$
$\sqrt{2^2} \quad 4 \quad 5$
$2 \quad 2$
$2x^5\sqrt{5}$

$\sqrt{80a^3}$ $4a\sqrt{5a}$ $a \cdot a \cdot a$
$20 \quad 4$
$10 \quad 2 \quad 2 \quad 2$
$5 \quad 2$
$2 \cdot 2a\sqrt{5a}$

$\sqrt{75a^6}$

$\sqrt[3]{27m^4n^{14}}$ $m \cdot m \cdot m \cdot m$
$9 \quad 3$
$3 \quad 3$

$3mn^4\sqrt[3]{mn^2}$

Plug in the list of values for "a" and determine what the rational exponent does to "a."
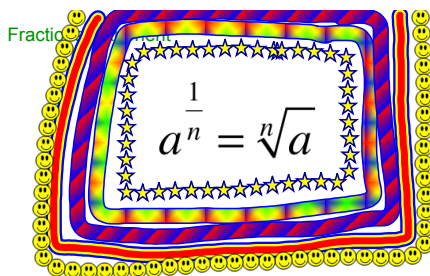
$1, 4, 9, 16, 25, 36$

$$a^{\left(\frac{1}{2}\right)} = \underline{\hspace{2cm}}$$

$1, 8, 27, 64, 125, 216$

$$a^{\left(\frac{1}{3}\right)} = \underline{\hspace{2cm}}$$

Fractio

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$

Write each of the following as a radical and simplify, if possible.

$$9^{\frac{1}{2}}$$ $$(-64)^{\frac{1}{3}}$$

$$\sqrt[2]{9^1} = 3$$ $$\sqrt[3]{-64}$$

$$(-4)$$

$$100^{\frac{1}{2}}$$ $$z^{\frac{1}{2}}$$ $$\sqrt{z}$$

$$\sqrt{100} = 10$$

Rewrite in exponent form

$$\sqrt[7]{x^1}$$ $$\sqrt[4]{b}$$ $$\sqrt[5]{d}$$

$$x^{\frac{1}{7}}$$ $$b^{\frac{1}{4}}$$ $$d^{\frac{1}{5}}$$