Square Root

$$\sqrt{x^2}$$

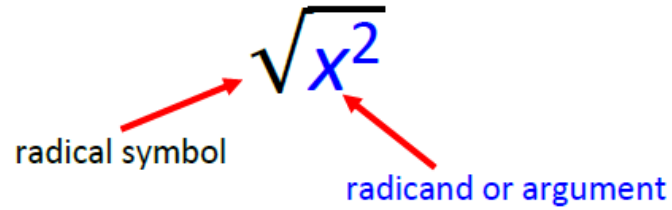radical symbol → √

radicand or argument → x^2
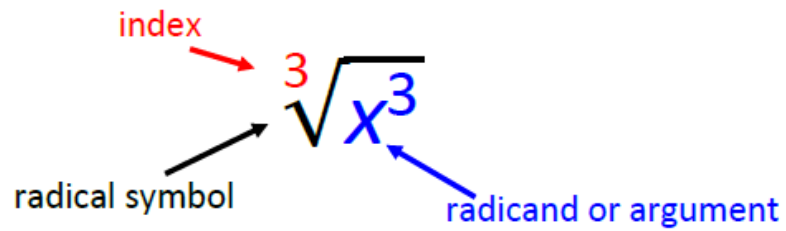
Simplify square root expressions.

Examples:

$\sqrt{9x^2} = \sqrt{3^2 \cdot x^2} = \sqrt{(3x)^2} = 3x$
$-\sqrt{(x-3)^2} = -(x-3) = -x + 3$

Squaring a number and taking a square root are inverse operations.

Cube Root

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

radical symbol

radicand or argument

Simplify cube root expressions.

Examples:

$\sqrt[3]{64} = \sqrt[3]{4^3} = 4$
$\sqrt[3]{-27} = \sqrt[3]{(-3)^3} = -3$
$\sqrt[3]{x^3} = x$

Cubing a number and taking a cube root
are inverse operations.

n^{th} Root

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$$\sqrt[n]{x^m} = x^{\frac{m}{n}}$$

radical symbol   radicand or argument

Examples:

$\sqrt[5]{64} = \sqrt[5]{4^3} = 4^{\frac{3}{5}}$
$\sqrt[6]{729x^9y^6} = 3x^{\frac{3}{2}}y$

Simplify Radical Expressions

Simplify radicals and combine like terms where possible.

Examples:

$$\frac{1}{2} + \sqrt[3]{-32} - \frac{11}{2} - \sqrt{8}$$

$$= -\frac{10}{2} - 2\sqrt[3]{4} - 2\sqrt{2}$$

$$= -5 - 2\sqrt[3]{4} - 2\sqrt{2}$$

$$\sqrt{18} - 2\sqrt[3]{27} = 2\sqrt{3} - 2(3)$$

$$= 2\sqrt{3} - 6$$

Add and Subtract Radical Expressions

Add or subtract the numerical factors of the like radicals.

Examples:

$$2\sqrt{a} + 5\sqrt{a}$$
$$= (2 + 5)\sqrt{a} = 7\sqrt{a}$$

$$6\sqrt[3]{xy} - 4\sqrt[3]{xy} - \sqrt[3]{xy}$$
$$= (6 - 4 - 1)\sqrt[3]{xy} = \sqrt[3]{xy}$$

$$2\sqrt[4]{c} + 7\sqrt{2} - 2\sqrt[4]{c}$$
$$= (2 - 2)\sqrt[4]{c} + 7\sqrt{2} = 7\sqrt{2}$$

Product Property of Radicals

The nth root of a product equals the product of the nth roots.

$$\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$$

$a \geq 0$ and $b \geq 0$

Examples:

$\sqrt{4x} = \sqrt{4} \cdot \sqrt{x} = 2\sqrt{x}$
$\sqrt{5a^3} = \sqrt{5} \cdot \sqrt{a^3} = a\sqrt{5a}$
$\sqrt[3]{16} = \sqrt[3]{8 \cdot 2} = \sqrt[3]{8} \cdot \sqrt[3]{2} = 2\sqrt[3]{2}$

Quotient Property of Radicals

The nth root of a quotient equals the quotient of the nth roots of the numerator and denominator.

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$a \geq 0$ and $b > 0$

Examples:

$$\sqrt{\frac{5}{y^2}} = \frac{\sqrt{5}}{\sqrt{y^2}} = \frac{\sqrt{5}}{y}, \ y \neq 0$$

$$\frac{\sqrt{25}}{\sqrt{3}} = \frac{5}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{5\sqrt{3}}{3}$$