Radicals - More than "Square Roots"

$\sqrt[2]{25}$

$\sqrt[2]{(5)^2}$

5

$2 \cdot 2 \cdot 2 = 8$

$\sqrt[3]{8}$

$\sqrt[3]{(2)^3}$

$= 2$

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

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

$\sqrt[5]{243}$

$\sqrt[5]{(3)^5}$

$= 3$

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

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

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Radicals - More than "Square Roots"

$\sqrt[2]{25}$ $\sqrt[3]{8}$ $\sqrt[5]{243}$

$(25)^{1/2}$ $(8)^{1/3}$ $(243)^{1/5}$

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$$\overline{\left(5\sqrt{7}\right)^2}$$

$(5\sqrt{7})(5\sqrt{7})$

$5 \cdot 5 \cdot \sqrt{7} \cdot \sqrt{7}$

$25 \cdot 7 = 175$

$$\sqrt{\frac{16}{49}} = \frac{\sqrt{16}}{\sqrt{49}} = \boxed{\frac{4}{7}}$$

$$\boxed{1/4}\sqrt{12}\cdot\boxed{5}\sqrt{6}$$

$\frac{1}{4} \cdot \frac{5}{1} = \frac{5}{4}$

$\sqrt{12} \cdot \sqrt{6} = \sqrt{72}$

$\sqrt{36 \cdot 2}$

$6\sqrt{2}$

$$\frac{\sqrt{18}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{36}}{2}$$

$\frac{\sqrt{36}}{2} = \frac{6}{2} = \boxed{3}$

answer

$\frac{1}{4}\sqrt{12} \cdot 5\sqrt{6}$

$\frac{1}{4} \cdot \frac{5}{1} = \frac{5}{4}$

$\sqrt{12} \cdot \sqrt{6} = \sqrt{72}$

$\sqrt{36 \cdot 2}$

$6\sqrt{2}$

$\frac{1}{4} \cdot \frac{5}{1} \cdot \sqrt{12} \cdot \sqrt{6}$

$\frac{5}{4} \rightarrow \frac{6\sqrt{2}}{1}$

$\frac{5 \cdot 6\sqrt{2}}{4 \cdot 1} = \frac{30\sqrt{2}}{4}$

$\frac{30\sqrt{2} \div 2}{4 \div 2} = \frac{15\sqrt{2}}{2}$

$$\sqrt{\frac{3}{5}}$$

$$\frac{4}{\sqrt{8}}$$

$$\frac{-3\sqrt{15}}{\sqrt{3}}$$

$$\sqrt{\frac{3}{5}} = \frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$$ ← $1 \cdot 15$, $2 \cdot 5$

$$\frac{4}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{4\sqrt{8}}{8}$$ ← simplify $\sqrt{8}$

$\sqrt{4 \cdot 2}$

$2\sqrt{2}$

$$\frac{4 \cdot 2\sqrt{2}}{8} = \frac{8\sqrt{2}}{8} = \boxed{\sqrt{2}}$$ answer

$$\frac{-3\sqrt{15}}{\sqrt{3}}$$

$$\frac{-3\sqrt{15}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{-3\sqrt{45}}{3} = -\sqrt{45}$$

$\sqrt{9 \cdot 5}$

$3\sqrt{5}$

$-3\sqrt{5}$

answer	$-3\sqrt{5}$

Addition and Subtraction of Radicals

Steps to add or subtract radicals:

1. Write each radical in simplest form.
2. Combine like radicals.
   (treat the radical like a variable)

$$5y + 6z - 11z$$

$$5\sqrt{2} + \sqrt{2}$$

$$3\sqrt{18} - \sqrt{25}$$

Addition and Subtraction of Radicals

Steps to add or subtract radicals:

1. Write each radical in simplest form.
2. Combine like radicals.
   (treat the radical like a variable)

$5y + 6z - 11z$ What combines?

same variable

$5\sqrt{2} + \sqrt{2}$

$5y - 5z$

$5(y - z)$ GCF

$3\sqrt{18} - \sqrt{25}$

$5\sqrt{2} + 1\sqrt{2} = 6\sqrt{2}$

$5+1=6$

$3\sqrt{18} - \sqrt{25}$

$\sqrt{9 \cdot 2}$

$3 \cdot 3\sqrt{2}$

$9\sqrt{2}$

$\sqrt{25}$

5

$9\sqrt{2} - 5$

answer $9\sqrt{2} - 5$

$6\sqrt{3} - 4\sqrt{5} - \sqrt{3}$ = $5\sqrt{3} - 4\sqrt{5}$

$\sqrt{54} + 2\sqrt{40} - 3\sqrt{96}$

$8\sqrt{72} - 3\sqrt{8} - \sqrt{98}$

$$\sqrt{54} + 2\sqrt{40} - 3\sqrt{96}$$

$\sqrt{9 \cdot 6}$ $\quad 2\sqrt{4 \cdot 10}$ $\quad 3 \cdot \sqrt{16 \cdot 6}$

$3\sqrt{6} + 4\sqrt{10}$ $\quad 2 \cdot 2\sqrt{10}$ $\quad 3 \cdot 4\sqrt{6}$

$= 12\sqrt{6}$

$-9\sqrt{6} + 4\sqrt{10}$

or

$4\sqrt{10} - 9\sqrt{6}$

$$8\sqrt{72} - 3\sqrt{8} - \sqrt{98}$$

$\sqrt{36 \cdot 2}$ $\quad 3 \cdot \sqrt{4 \cdot 2}$ $\quad \sqrt{49 \cdot 2}$

$8 \cdot 6\sqrt{2}$ $\quad 3 \cdot 2\sqrt{2}$ $\quad 7\sqrt{2}$

$48\sqrt{2} - 6\sqrt{2} - 7\sqrt{2}$

$35\sqrt{2}$

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Solving Quadratic Equations using Radicals

$$\frac{2x^2}{2} = \frac{98}{2}$$

$\sqrt{x^2} = \pm\sqrt{49}$ why? $7 \cdot 7 = 49$

$x = \pm 7$ $(-7)\cdot(-7) = 49$

$$\frac{108x^2}{108} = \frac{72}{108}$$

$$x^2 = \frac{72}{108} = \frac{36}{54} = \frac{18}{27} = \frac{2}{3}$$

$$\sqrt{x^2} = \pm\sqrt{\frac{2}{3}}$$

$$x = \pm\frac{\sqrt{2}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \pm\frac{\sqrt{6}}{3}$$

$$3x^2 - 11 = 124$$

$+11 \quad +11$

$$\frac{3x^2}{3} = \frac{135}{3}$$

$$x^2 = \frac{135}{3}$$

$$\sqrt{x^2} = \pm\sqrt{45}$$

$$x = \pm\sqrt{45} \rightsquigarrow \pm\sqrt{9 \cdot 5}$$

$$x = \pm 3\sqrt{5}$$

$$\frac{7}{x} = \frac{x}{21}$$

$$7(21) = x^2$$

$$\pm\sqrt{147} = \sqrt{x^2}$$

$$\sqrt{49 \cdot 3} \therefore x$$

$$\pm 7\sqrt{3} = x$$

Radicals - More than "Square Roots"

$\sqrt[2]{25}$

$\sqrt{5 \cdot 5} = 5$

$\sqrt{5^2} = 5$

$\sqrt[3]{8}$

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

$\sqrt[3]{(2)^3} = 2$

$\sqrt[5]{243}$

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

$\sqrt[5]{(3)^5} = 3$

$= 3$

Radicals - More than "Square Roots"

$\sqrt[2]{25}'$ $\sqrt[3]{8}'$ $\sqrt[5]{243}'$

$(25)^{1/2}$ $(8)^{1/3}$ $(243)^{1/5}$

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$$\left(5\sqrt{7}\right)^2$$

$(5\sqrt{7})(5\sqrt{7})$

$5 \cdot 5 \cdot \sqrt{7} \cdot \sqrt{7}$

$25 \cdot 7 = 175$

$$\frac{1}{4}\sqrt{12} \cdot 5\sqrt{6}$$

$$\sqrt{\frac{16}{49}} = \frac{\sqrt{16}}{\sqrt{49}} = \frac{4}{7}$$

$$\frac{\sqrt{18}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{36}}{2}$$

$3\sqrt{2}$ 3

$\frac{3\sqrt{2}}{\sqrt{2}} = 3$

$\frac{\sqrt{36}}{2} = \frac{6}{2} = 3$

$$\frac{1}{4}\sqrt{12}\cdot 5\sqrt{6}$$

$\frac{1}{4}\cdot\sqrt{12}\cdot 5\cdot\sqrt{6}$

$\frac{1}{4}\cdot\frac{5}{1}\cdot\sqrt{12}\cdot\sqrt{6}$

$\frac{5}{4}\cdot\sqrt{72}$

$\frac{5}{4}\sqrt{72}$

$5/4\ \sqrt{36\cdot 2}$

$5\cdot 6\sqrt{2}$

$\frac{30\sqrt{2}}{4}$

$\frac{15}{2}\sqrt{2} = \frac{15\sqrt{2}}{2}$

answer

$\frac{15}{2}\cdot\frac{\sqrt{2}}{1} : \frac{15\sqrt{2}}{2}$

$\frac{1}{4}\sqrt{12} \cdot 5\sqrt{6}$

$\frac{1}{4} \cdot \frac{5}{1} = \frac{5}{4}$

$\sqrt{12} \cdot \sqrt{6} = \sqrt{72}$

$\sqrt{36 \cdot 2}$

$6\sqrt{2}$

$$\sqrt{\frac{3}{5}}$$

$$\frac{4}{\sqrt{8}}$$

$$\frac{-3\sqrt{15}}{\sqrt{3}}$$

$\sqrt{\frac{3}{5}}$ $\frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$

$\frac{4}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{4\sqrt{8}}{8} = \frac{\sqrt{8}}{2}$ $\sqrt{8}$ / $\sqrt{4 \cdot 2}$ $\frac{2\sqrt{2}}{2} = \sqrt{2}$

$\frac{-3\sqrt{15}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{-3\sqrt{45}}{3} = -\sqrt{45}$

$-\sqrt{9 \cdot 5}$

$-3\sqrt{5}$ answer

$\sqrt{15} \rightarrow 1 \cdot 15$, $3 \cdot 5$

$\sqrt{15}$

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

$$\frac{4}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{4\sqrt{8}}{8} = \frac{\sqrt{8}}{2} \quad \sqrt{8} = \sqrt{4 \cdot 2} \quad \frac{2\sqrt{2}}{2} = \sqrt{2}$$

$$\frac{4}{2\sqrt{2}} = \frac{2}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{2}}{2} = \sqrt{2}$$

Addition and Subtraction of Radicals

Steps to add or subtract radicals:

1. Write each radical in simplest form.
2. Combine like radicals.
   (treat the radical like a variable)

$5y + 6z - 11z$ $\quad 5y - 5z \quad$ GCF $\quad 5(y - z)$

$5\sqrt{2} + 1\sqrt{2} = 6\sqrt{2}$

$\sqrt{2} + \sqrt{2} + \sqrt{2} + \sqrt{2} + \sqrt{2} + \sqrt{2}$

$3\sqrt{18} - \sqrt{25}$

$3 \cdot \sqrt{9 \cdot 2}$ $\quad 5$

$3 \cdot 3\sqrt{2}$

$9\sqrt{2} - 5$

$9\sqrt{2} - 5$

Addition and Subtraction of Radicals

Steps to add or subtract radicals:

1. Write each radical in simplest form.
2. Combine like radicals.
   (treat the radical like a variable)

$$5y + 6z - 11z$$

$$5\sqrt{2} + \sqrt{2}$$

$$3\sqrt{18} - \sqrt{25}$$

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$$5\sqrt{2}+\sqrt{2}$$

$$3\sqrt{18}-\sqrt{25}$$

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$$6\sqrt{3} - 4\sqrt{5} - \sqrt{3}$$

$$\sqrt{54} + 2\sqrt{40} - 3\sqrt{96}$$

$$8\sqrt{72} - 3\sqrt{8} - \sqrt{98}$$

$$\sqrt{54}+2\sqrt{40}-3\sqrt{96}$$

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$$8\sqrt{72} - 3\sqrt{8} - \sqrt{98}$$

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Solving Quadratic Equations using Radicals

$$\frac{2x^2}{2} = \frac{98}{2}$$

$$x^2 = 49$$

$$\sqrt{x^2} = \pm\sqrt{49}$$

$$x = \pm 7$$

$$\frac{108x^2}{108} = \frac{72}{108}$$

$$x^2 = \frac{72}{108} = \frac{8}{12} = \frac{2}{3}$$

$$\sqrt{x^2} = \pm\sqrt{\frac{2}{3}}$$

$$x = \pm\sqrt{\frac{2}{3}}$$

$$x = \pm\frac{\sqrt{2}\cdot\sqrt{3}}{\sqrt{3}\cdot\sqrt{3}} = \pm\frac{\sqrt{6}}{3}$$

$$3x^2 - 11 = 124$$

$$\frac{7}{x} = \frac{x}{21}$$

Radicals - More than "Square Roots"

$\sqrt[2]{25}$

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

$= 5$

$= 5\sqrt[2]{(5)^2}$

$\sqrt[3]{8}$

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

$\sqrt[3]{(2)^3}$

$= 2$

$\sqrt[5]{243}$

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

$= 3$

$\sqrt[5]{(3)^5}$

$= 3$

Radicals - More than "Square Roots"

$\sqrt[2]{25}'$ $\sqrt[3]{8}'$ $\sqrt[5]{243}'$

$(25)^{1/2}$ $(8)^{1/3}$ $(243)^{1/5}$

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$$(5\sqrt{7})^2$$

$(5\sqrt{7})(5\sqrt{7})$

$5 \cdot 5 \cdot \sqrt{7} \cdot \sqrt{7}$

$25 \cdot 7 = 175$

$$\frac{1}{4}\sqrt{12} \cdot 5\sqrt{6}$$

$$\sqrt{\frac{16}{49}} = \frac{\sqrt{16}}{\sqrt{49}} = \frac{4}{7}$$

$$\frac{\sqrt{18}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{36}}{2}$$

$\sqrt{18}$

$\sqrt{9 \cdot 2}$

$3\sqrt{2}$

$$\frac{3\sqrt{2}}{\sqrt{2}} = 3$$

$\frac{\sqrt{36}}{2} = \frac{6}{2} = 3$

$\sqrt{\frac{18}{2}} = \sqrt{9} = 3$

$(5\sqrt{7})^2$

$(5\sqrt{7})(5\sqrt{7})$

what if...

$(5+\sqrt{7})^2$

$(5+\sqrt{7})(5+\sqrt{7})$

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$$\frac{1}{4}\sqrt{12}\cdot 5\sqrt{6}$$

$\frac{1}{4}\cdot\sqrt{12}\cdot 5\cdot\sqrt{6}$

$\frac{1}{4}\to\frac{5}{1}\cdot\sqrt{12}\cdot\sqrt{6}$

$\frac{5}{4}\cdot\sqrt{12}\cdot\sqrt{6}$

$\frac{5}{4}\cdot\sqrt{72}$

$\frac{5}{4}\cdot\sqrt{36\cdot 2}$

$\frac{5}{4}\cdot\frac{6}{1}\sqrt{2}$

$\frac{30}{4}\sqrt{2}$

$\boxed{\frac{15\sqrt{2}}{2}}$ answer

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$$\frac{1}{4}\sqrt{12}\cdot 5\sqrt{6}$$

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$\frac{1}{4}\sqrt{12} \cdot 5\sqrt{6}$

$\frac{1}{4} \cdot \frac{5}{1} = \frac{5}{4}$

$\sqrt{12} \cdot \sqrt{6} = \sqrt{72}$

$\sqrt{36 \cdot 2}$

$6\sqrt{2}$

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$$\sqrt{\frac{3}{5}}$$

$$\frac{4}{\sqrt{8}}$$

$$\frac{-3\sqrt{15}}{\sqrt{3}}$$

$$\sqrt{\frac{3}{5}} = \frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$$

$$\frac{4}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{4\sqrt{8}}{8} = \frac{\sqrt{8}}{2} = \frac{2\sqrt{2}}{2} = \sqrt{2}$$

$\sqrt{4 \cdot 2}$

$$\frac{-3\sqrt{15}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{-3\sqrt{45}}{3} = -\sqrt{45}$$

$\sqrt{9 \cdot 5}$

$-3\sqrt{5}$

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

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$$\frac{4}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{4\sqrt{8}}{8} = \frac{\sqrt{8}}{2} = \frac{\sqrt{4\cdot 2}}{2} = \frac{2\sqrt{2}}{2} = \sqrt{2}$$

$$\frac{4}{2\sqrt{2}} = \frac{2}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{2}}{2} = \sqrt{2}$$

$$\frac{4\sqrt{8}}{8} = \frac{4\cdot 2\sqrt{2}}{8} = \frac{8\sqrt{2}}{8} = \sqrt{2}$$

$$\frac{4}{\sqrt{8}} \cdot \frac{\sqrt{8}}{\sqrt{8}} = \frac{4\sqrt{8}}{8} = \frac{\sqrt{8}}{2} \quad \sqrt{8} = \sqrt{4 \cdot 2} \quad \frac{2\sqrt{2}}{2} = \sqrt{2}$$

Addition and Subtraction of Radicals

Steps to add or subtract radicals:

1. Write each radical in simplest form.
2. Combine like radicals.
   (treat the radical like a variable)

GCF

$5y + 6z - 11z$ $5y - 5z$ $5(y - z)$

$5\sqrt{2} + \sqrt{2}$ $6\sqrt{2}$

$3\sqrt{18} - \sqrt{25}$

$3\sqrt{9 \cdot 2}$ $\sqrt{25}$

$3 \cdot 3\sqrt{2}$

$9\sqrt{2} - 5$

$9x - 5$

$9\sqrt{2} - 5$

Addition and Subtraction of Radicals

Steps to add or subtract radicals:

1. Write each radical in simplest form.
2. Combine like radicals.
   (treat the radical like a variable)

$$5y + 6z - 11z$$

$$5\sqrt{2} + \sqrt{2}$$

$$3\sqrt{18} - \sqrt{25}$$

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$$5\sqrt{2}+\sqrt{2}$$

$$3\sqrt{18}-\sqrt{25}$$

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$6\sqrt{3} - 4\sqrt{5} - \sqrt{3}$

$5\sqrt{3} - 4\sqrt{5}$
$-4\sqrt{5} + 5\sqrt{3}$

$\sqrt{54} + 2\sqrt{40} - 3\sqrt{96}$

$8\sqrt{72} - 3\sqrt{8} - \sqrt{98}$

$$\sqrt{54}+2\sqrt{40}-3\sqrt{96}$$

$\sqrt{9\cdot 6}$ $\quad$ $\sqrt{4\cdot 10}$ $\quad$ $3\cdot\sqrt{16\cdot 6}$

$2\cdot 2\sqrt{10}$ $\quad$ $3\cdot 4\sqrt{6}$

$3\sqrt{6} + 4\sqrt{10} - 12\sqrt{6}$

$4\sqrt{10} - 9\sqrt{6}$

$$8\sqrt{72} - 3\sqrt{8} - \sqrt{98}$$

$8 \cdot \sqrt{36 \cdot 2}$ $3 \cdot \sqrt{4 \cdot 2}$ $\sqrt{49 \cdot 2}$

$8 \cdot 6\sqrt{2}$ $3 \cdot 2\sqrt{2}$ $7\sqrt{2}$

$48\sqrt{2} - 6\sqrt{2} - 7\sqrt{2}$

$35\sqrt{2}$

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Solving Quadratic Equations using Radicals

$$\frac{2x^2}{2} = \frac{98}{2}$$

$$\sqrt{x^2} = \pm\sqrt{49}$$

$$x = \pm 7$$

$$\sqrt{x} + 5 = 10$$

$$\sqrt{x} = 5$$

$$x = 25$$

$$\frac{108x^2}{108} = \frac{72}{108}$$

$$x^2 = \frac{72}{108} = \frac{36}{54} = \frac{18}{27} = \frac{6}{9} = \boxed{\frac{2}{3}}$$

$$\sqrt{x^2} = \pm\sqrt{\frac{2}{3}} \qquad x = \pm\sqrt{\frac{2}{3}} = \pm\frac{\sqrt{2}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \boxed{\pm\frac{\sqrt{6}}{3}}$$

$$3x^2 - 11 = 124$$

$$\frac{7}{x} = \frac{x}{21}$$