

**Algebra II**  
**4.5 Square Roots & Solving Quadratic Equations Using Square Roots**

Obj: To simplify square roots and to solve a quadratic equation using a square root.

Make a list of perfect squares:  
1, 4, 9, ...

x	1	2	3	4	5	6	7	8	9	10	11	12	13	14
x <sup>2</sup>	1	4	9	16	25	36	49	64	81	100	121	144	169	196

Simplifying Square Roots:

$$\sqrt{25} = 5$$

$$\sqrt{49} = 7$$

$$\sqrt{144} = 12$$

$$\sqrt{50} = \sqrt{2 \cdot 25} = 5\sqrt{2}$$

$$\sqrt{12} = \sqrt{4 \cdot 3} = 2\sqrt{3}$$

### Simplifying Square Roots:

$$\begin{array}{ll} \sqrt{32} = \sqrt{4} \cdot \sqrt{8} = 2\sqrt{8} & \sqrt{\frac{9}{100}} = \frac{3}{10} \\ \sqrt{500} = \sqrt{100} \cdot \sqrt{5} = 10\sqrt{5} & \sqrt{\frac{20}{49}} = (\sqrt{4} \cdot \sqrt{5}) = \frac{2\sqrt{5}}{7} \\ 2\sqrt{72} = 2(\sqrt{8} \cdot \sqrt{9}) = 6\sqrt{8} & 7\sqrt{\frac{36}{3}} = (7 \cdot 6) = 42\sqrt{\frac{1}{3}} \\ \sqrt{30} = \sqrt{30} & \\ 5\sqrt{24} = 5(\sqrt{4} \cdot \sqrt{6}) = 10\sqrt{6} & \sqrt{\frac{7}{16}} = \frac{\sqrt{7}}{4} \end{array}$$

### Add, Sub, & Mult Square Roots:

$$\begin{array}{ll} \sqrt{6} * \sqrt{10} = \sqrt{60} = (\sqrt{4} \cdot \sqrt{15}) = 2\sqrt{15} & 5\sqrt{10} * \sqrt{10} = 5\sqrt{100} = 50 \\ \sqrt{6} * \sqrt{15} = \sqrt{90} = (\sqrt{9} \cdot \sqrt{10}) = 3\sqrt{10} & 4\sqrt{3} * 2\sqrt{5} = 8\sqrt{15} \\ \sqrt{7} * \sqrt{7} = 7 & \sqrt{\frac{10}{3}} * \sqrt{\frac{7}{5}} = \sqrt{\frac{70}{15}} \end{array}$$

## Add, Sub, & Mult Square Roots:

$$3\sqrt{2} + 5\sqrt{2} = 8\sqrt{2}$$

$$-2\sqrt{5} + 9\sqrt{5} = 7\sqrt{5}$$

$$3\sqrt{12} + 5\sqrt{27} = 6\sqrt{3} + 15\sqrt{3} = 21\sqrt{3}$$

$(\sqrt{4} \cdot \sqrt{3})$     $(\sqrt{3} \cdot \sqrt{9})$

Bases  
must  
be  
the  
same to  
add or  
subtract.

## Rationalizing:

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

$$\frac{\sqrt{32} \cdot \sqrt{10}}{\sqrt{10} \cdot \sqrt{10}} = \frac{\sqrt{64 \cdot 5}}{10} = \frac{8\sqrt{5}}{10} = \frac{4\sqrt{5}}{5}$$

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

$$\frac{2\sqrt{5} \cdot \sqrt{10}}{3\sqrt{10} \cdot \sqrt{10}} = \frac{2\sqrt{50}}{30} = \frac{\sqrt{50}}{15}$$

$$\frac{3\sqrt{7}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{3\sqrt{14}}{2}$$

$$\sqrt{\frac{1}{2}} * \sqrt{\frac{3}{5}} = \frac{\sqrt{3} \cdot \sqrt{10}}{\sqrt{10} \cdot \sqrt{10}} = \frac{\sqrt{30}}{10}$$

$$\sqrt{\frac{40}{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{4 \cdot 30}}{3} = \frac{2\sqrt{30}}{3}$$

**Rationalizing using a conjugate:**

$\frac{3}{5+\sqrt{6}} \cdot \frac{5-\sqrt{6}}{5-\sqrt{6}}$ $\frac{15-3\sqrt{6}}{25-\underbrace{5\sqrt{6}+5\sqrt{6}-6}_{\text{cancel}}} = \frac{15-3\sqrt{6}}{19}$ $\frac{\sqrt{2}}{5+2\sqrt{3}} \cdot \frac{5-2\sqrt{3}}{5-2\sqrt{3}}$ $\frac{5\sqrt{2}-2\sqrt{6}}{25-10\sqrt{3}+10\sqrt{3}-12} = \frac{5\sqrt{2}-2\sqrt{6}}{13}$	$\frac{3}{5-\sqrt{6}} \cdot \frac{5+\sqrt{6}}{5+\sqrt{6}}$ $\frac{-15+3\sqrt{6}}{25-5\sqrt{6}+5\sqrt{6}-6} = \frac{15+3\sqrt{6}}{19}$ $\frac{3+\sqrt{6}}{5+\sqrt{6}} \cdot \frac{5-\sqrt{6}}{5-\sqrt{6}} =$ $\frac{15-3\sqrt{6}+5\sqrt{6}-6}{25-5\sqrt{6}+5} = \frac{2\sqrt{6}+9}{20-5\sqrt{6}}$
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Given  $x^2=16$ , what could  $x$  equal?

**$x=4$  or  $x=-4$**

**can be written as**

$$x = \pm 4$$

Examples, Solve for x.

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

$$\sqrt{x^2=40} \quad x = \sqrt{40}$$
$$= \pm 2\sqrt{10}$$

$$x^2 = -15$$

↑  
No solution

Examples, Solve for x.

$$x^2 - 5 = 70$$
$$\sqrt{x^2 = 75}$$
$$x = \sqrt{75}$$
$$x = \sqrt{25 \cdot 3}$$
$$x = \pm 5\sqrt{3}$$

$$2x^2 + 1 = 17$$
$$2x^2 = 16$$
$$\frac{2}{2}$$
$$\sqrt{x^2 = 4}$$
$$x = \pm 2$$

$$3 - 5x^2 = -9$$
$$\frac{-3}{-5}$$
$$-5x^2 = -12$$
$$\frac{-5}{-5}$$

$$\sqrt{x^2 = \frac{12}{5}}$$
$$x = \pm 2\sqrt{\frac{3}{5}}$$

Equations of the form  $(x-\#)^2 = \#$ .

- Take the square roots of both sides
- split into 2 equations  
(positive & negative of the right side)

Examples:

$$\sqrt{(x-3)^2} = 49$$

$$x-3 = \pm 7$$

$$x-3 = 7$$

$$x-3 = -7$$

$$x = 10$$

$$x = -4$$

$$\sqrt{(x+5)^2} = 40$$

$$x+5 = \pm 2\sqrt{10}$$

$$x = \pm 2\sqrt{10} - 5$$

Examples:

Divide  
by  
3 first →

$$3(x-2)^2=21$$

$$\frac{3(x-2)^2=21}{3}$$

$$\sqrt{(x-2)^2}=7 = x-2=\pm\sqrt{7}$$

$$x = \pm\sqrt{7}+2$$

mult by  
3 first →

$$3 \cdot \frac{1}{3}(x+5)^2=7 \cdot 3$$

$$\sqrt{(x+5)^2}=21 = x+5=\pm\sqrt{21}$$

$$x = -5 \pm \sqrt{21}$$

When you take the square root of both sides, don't forget the  $\pm$  !!!!