Operations with Square Roots Vocabulary

radical symbol

radical expression

radicand

A square root symbol, $\sqrt{}$, is called a **radical symbol**. An expression containing a radical symbol is called a radical expression. The value under a radical symbol is called the **radicand**.

You can use the Distributive Property to combine like terms in radical expressions.

Simplify.

$3\sqrt{6} + 4\sqrt{6}$

$3\sqrt{6} + 4\sqrt{6} = (3+4)\sqrt{6}$ *The radicands are the same.*

$= 7\sqrt{6}$ *Combine like terms.*

Simplify.

$$2\sqrt{7} + 9\sqrt{3} - 8\sqrt{7}$$

$$2\sqrt{7} + 9\sqrt{3} - 8\sqrt{7} = 2\sqrt{7} - 8\sqrt{7} + 9\sqrt{3}$$

Commutative Property

$$= (2 - 8)\sqrt{7} + 9\sqrt{3}$$

Combine like terms.

$$= -6\sqrt{7} + 9\sqrt{3}$$

$$= 9\sqrt{3} - 6\sqrt{7}$$

Simplify.

$-3\sqrt{11} + 2\sqrt{11}$

$(-3 + 2)\sqrt{11} = -\sqrt{11}$

Simplify.

$$-\sqrt{14} + 4\sqrt{15} + \sqrt{14}$$

$-\sqrt{14} + \sqrt{14} + 4\sqrt{15}$
$= (-1 + 1)\sqrt{14} + 4\sqrt{15}$
$= 4\sqrt{15}$

MULTIPLICATION PROPERTY OF SQUARE ROOTS

Words	Algebra	Numbers
The product of square roots is equal to the square root of the product of the radicands.	For all numbers $a \geq 0$ and $b \geq 0$, $\sqrt{a}\sqrt{b} = \sqrt{ab}$.	$\sqrt{9} \cdot \sqrt{4} = \sqrt{9 \cdot 4}$ $= \sqrt{36}$ $= 6$

Simplify.

$$\sqrt{18} \bullet \sqrt{8}$$

$$\sqrt{18} \bullet \sqrt{8} = \sqrt{18 \bullet 8}$$

$$= \sqrt{144}$$

$$= \sqrt{12}$$

Multiply the radicands under one radical symbol.

Simplify.

$4\sqrt{20} \bullet \sqrt{20}$

$$4\sqrt{20} \bullet \sqrt{20} = 4\sqrt{20 \bullet 20}$$
$$= 4\sqrt{400}$$
$$= 4 \bullet 20$$
$$= 80$$

Multiply the radicands under one radical symbol.

Simplify.

$\sqrt{5} \cdot \sqrt{20}$

$\sqrt{5 \cdot 20} = \sqrt{100}$

$= 10$

Simplify.

$\sqrt{2} \bullet 2\sqrt{2}$

$2\sqrt{2 \bullet 2} = 2\sqrt{4}$

$= 2 \bullet 2$

$= 4$

Simplify.

$\sqrt{162}$

Method A

$$\sqrt{162} = \sqrt{2} \bullet \sqrt{81}$$

$$= 9\sqrt{2}$$

Method B

$$\sqrt{162} = \sqrt{9 \bullet 18}$$

$$= \sqrt{9} \bullet \sqrt{18}$$

$$= 3 \bullet \sqrt{9 \bullet 2}$$

$$= 3 \bullet \sqrt{9} \bullet \sqrt{2}$$

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

$$= 9\sqrt{2}$$

Simplify.

$\sqrt{180}$

$$\sqrt{180} = \sqrt{36 \cdot 5}$$

$$= \sqrt{36} \cdot \sqrt{5}$$

Possible solution: $= 6\sqrt{5}$

Simplify.

$7\sqrt{5} - \sqrt{125}$

$7\sqrt{5} - \sqrt{125} = 7\sqrt{5} - \sqrt{25 \cdot 5}$

Find perfect square factors of the radicand.

$= 7\sqrt{5} - \sqrt{25} \cdot \sqrt{5}$

$= 7\sqrt{5} - 5\sqrt{5}$

Simplify.

$= 2\sqrt{5}$

Combine like terms.

Simplify.

$\sqrt{63} + 3\sqrt{28}$

$\sqrt{63} + 3\sqrt{28} = \sqrt{9 \bullet 6} + 3\sqrt{4 \bullet 7}$ *Find perfect square factors of the radicand.*

$= 3\sqrt{6} + 6\sqrt{7}$ *Simplify.*

$= 9\sqrt{7}$ *Combine like terms.*

Simplify.

$5\sqrt{3} - \sqrt{27}$

$$5\sqrt{3} - \sqrt{9} \bullet 3 = 5\sqrt{3} - 3\sqrt{3}$$

$$= 2\sqrt{3}$$

Simplify.

$2\sqrt{24} + 6\sqrt{54}$

$$2\sqrt{4} \cdot 6 + 6\sqrt{9} \cdot 6 = 4\sqrt{6} + 18\sqrt{6}$$

$$= 22\sqrt{6}$$