

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Notes

Algebra Section 11.2

Pages 719-726



**Goal:** “Simplify radicals using the product property”  
“Multiply radicals”  
“Simplify radicals using the quotient property”  
“Rationalize the denominator”  
“Add and Subtract Radicals”

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### Radicals are simplest form when:

1. The number under the \_\_\_\_\_ has no \_\_\_\_\_.
2. No \_\_\_\_\_ have an \_\_\_\_\_ greater than 1.
3. There are no \_\_\_\_\_ under the radical sign.
4. There are no \_\_\_\_\_ in the \_\_\_\_\_.

### Properties of Radicals

**Product Property:**  $\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b}$  or  $\sqrt{a} \cdot \sqrt{b} = \sqrt{ab}$  so....  
 $\sqrt{4 \cdot 9} = \sqrt{4} \cdot \sqrt{9} = 2 \cdot 3 = 6$

**Quotient Property:**  $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$  or  $\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$  so....

$$\sqrt{\frac{9}{16}} = \frac{\sqrt{9}}{\sqrt{16}} = \frac{3}{4}$$

Examples (Simplifying):

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

$$\sqrt{48} = \frac{\sqrt{16} \cdot \sqrt{3}}{4\sqrt{3}}$$

$$\sqrt{125} = \frac{\sqrt{25} \cdot \sqrt{5}}{5\sqrt{5}}$$

(Find the square root of the perfect square)

Try These:

$\sqrt{50}$

$\sqrt{12}$

$\sqrt{27}$

$\sqrt{32}$

$\sqrt{28}$

$\sqrt{48}$

$\sqrt{72}$

$\sqrt{80}$

$\sqrt{162}$

$\sqrt{600}$

Examples (variables):

$$\frac{\sqrt{x^2}}{x} \quad x \cdot x = x^2$$

$$\frac{\sqrt{a^2}}{a}$$

Try These:

$$\sqrt{y^2}$$

$$\sqrt{g^2}$$

$$\sqrt{b^2}$$

Examples (Multiplication):

$$\sqrt{9x^2} = \sqrt{9} \cdot \sqrt{x^2} = 3x$$

$$\sqrt{18x^2} = \sqrt{9} \cdot \sqrt{2} \cdot \sqrt{x^2} = 3x\sqrt{2}$$

Try These:

$$\sqrt{16x^2}$$

$$\sqrt{4x^2}$$

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

$$\sqrt{27a^2}$$

$$\sqrt{20b}$$

$$\sqrt{64x^2}$$

$$\sqrt{8x}$$

$$\sqrt{81x^2}$$

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

$$\sqrt{12x^2y}$$

Examples (Multiplication):

$$\sqrt{6} \cdot \sqrt{6} = \sqrt{36} = 6$$

$$4\sqrt{x} \cdot \sqrt{3x} = 4\sqrt{3x \cdot x} = 4 \cdot \sqrt{3} \cdot \sqrt{x^2} = 4x\sqrt{3}$$

Try These:

$$\sqrt{2} \cdot \sqrt{8}$$

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

$$\sqrt{5x} \cdot 3\sqrt{x}$$

$$\sqrt{2} \cdot \sqrt{12}$$

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

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

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

$$4\sqrt{5} \cdot 2\sqrt{10}$$

Examples (Division):

$$\sqrt{\frac{13}{100}} = \frac{\sqrt{13}}{\sqrt{100}} = \frac{\sqrt{13}}{10}$$

$$\sqrt{\frac{7}{x^2}} = \frac{\sqrt{7}}{\sqrt{x^2}} = \frac{\sqrt{7}}{x}$$

Try These:

$$\sqrt{\frac{3}{9}}$$

$$\sqrt{\frac{5}{n^2}}$$

$$\sqrt{\frac{a}{b^2}}$$

$$\sqrt{\frac{w}{144}}$$

### Rationalize the Denominator:

Radicals in the denominator (not perfect square).

Examples:

$$\frac{3}{\sqrt{7}} \quad \text{Multiply by } \frac{\sqrt{7}}{\sqrt{7}} \quad \frac{3}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{3\sqrt{7}}{\sqrt{49}} = \frac{3\sqrt{7}}{7}$$

$$\frac{\sqrt{5}}{\sqrt{2m}} \quad \text{Multiply by } \frac{\sqrt{2m}}{\sqrt{2m}} \quad \frac{\sqrt{5}}{\sqrt{2m}} \cdot \frac{\sqrt{2m}}{\sqrt{2m}} = \frac{\sqrt{10m}}{\sqrt{4m^2}} = \frac{\sqrt{10m}}{2m}$$

Try These:

$$\frac{1}{\sqrt{5}}$$

$$\frac{1}{\sqrt{x}}$$

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

$$\frac{5}{\sqrt{7}}$$

$$\frac{\sqrt{2a}}{\sqrt{a}}$$

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

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

$$\frac{5}{\sqrt{x}}$$

$$\frac{4}{\sqrt{n}}$$

$$\frac{\sqrt{a}}{\sqrt{2}}$$

$$\frac{1}{\sqrt{5}}$$

$$\frac{3}{\sqrt{x}}$$

$$\frac{2}{\sqrt{x}}$$

$$\frac{5}{\sqrt{6}}$$

$$\frac{\sqrt{2a}}{\sqrt{8}}$$

### Add and Subtract Radicals:

Radicals are like terms when: when the number under the radical sign (The radicand) is exactly the same. Combine like radical terms by adding or subtracting the coefficient.

Examples:

$$\begin{array}{r} 3\sqrt{5} + 7\sqrt{5} \\ 10\sqrt{5} \end{array}$$

$$\begin{array}{r} 4\sqrt{10} + \sqrt{13} - 9\sqrt{10} \\ 4\sqrt{10} - 9\sqrt{10} + \sqrt{13} \\ -5\sqrt{10} + \sqrt{13} \end{array}$$

$$\begin{array}{r} 5\sqrt{3} + \sqrt{48} \\ 5\sqrt{3} + \sqrt{16 \cdot 3} \\ 5\sqrt{3} + 4\sqrt{3} \\ 9\sqrt{3} \end{array}$$

Try These:

$$2\sqrt{3} + 4\sqrt{3}$$

$$\sqrt{6} + 2\sqrt{6} + 3\sqrt{6}$$

$$7\sqrt{5} - 2\sqrt{5}$$

$$2\sqrt{5} - 8\sqrt{5}$$

$$2\sqrt{2} + \sqrt{8}$$

$$4\sqrt{3} + 2\sqrt{27}$$

$$7\sqrt{14} + \sqrt{21} - 4\sqrt{14}$$

$$2\sqrt{7} + 3\sqrt{63}$$

$$2\sqrt{7} + \sqrt{28}$$

**Distribute:** (combine like terms if possible)

Example:

$$\begin{array}{r} \sqrt{5}(4 - \sqrt{20}) \\ 4\sqrt{5} - \sqrt{100} \\ 4\sqrt{5} - 10 \end{array}$$

$$\begin{array}{r} (3\sqrt{2})^2 = 3\sqrt{2} \cdot 3\sqrt{2} \\ 9\sqrt{4} \\ 9 \cdot 2 = 18 \end{array}$$

Try These:

$$\sqrt{3}(2 + \sqrt{12})$$

$$3(\sqrt{2} - 3\sqrt{5})$$

$$\sqrt{2}(3 + \sqrt{2})$$

$$(4\sqrt{3})^2$$

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

$$\sqrt{2}(3\sqrt{2} + 7)$$

Mixed Practice:

Simplify:

$\sqrt{98}$

$\sqrt{18x^2}$

$\sqrt{4a^2}$

$\sqrt{20b}$

Multiply and Simplify:

$\sqrt{3} \cdot \sqrt{6}$

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

$\sqrt{2} \cdot \sqrt{10}$

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

$3\sqrt{8} \cdot \sqrt{3}$

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

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

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

$3(2\sqrt{2} - 5)$

$\sqrt{2}(3\sqrt{6} + \sqrt{24})$

$(2\sqrt{6})^2$

Divide and Simplify

$\sqrt{\frac{1}{4}}$

$\sqrt{\frac{2}{n^2}}$

$\sqrt{\frac{5}{x^2}}$

$\sqrt{\frac{w}{100}}$

$\sqrt{\frac{64}{9x^2}}$

$\frac{1}{\sqrt{3}}$

$\frac{1}{\sqrt{b}}$

$\frac{5}{\sqrt{x}}$

$\frac{7}{\sqrt{3}}$

$\frac{\sqrt{5a}}{\sqrt{a}}$

Add and Subtract:

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

$\sqrt{7} + 4\sqrt{7} - 3\sqrt{7}$

$2\sqrt{3} - 8\sqrt{3}$

$2\sqrt{8} + \sqrt{32} - 4\sqrt{12}$

$4\sqrt{6} + 3\sqrt{24}$

$2\sqrt{5} + \sqrt{500}$