

Warm Up!

Simplify the following expression. Be sure to rationalize your denominator!

$$\sqrt{\frac{8}{6}} \div 2 = \sqrt{\frac{4}{3}} = \frac{\sqrt{4}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{12}}{3}$$

$\sqrt{12} \rightarrow$

| | |
|----|---|
| 12 | |
| 3 | 4 |
| — | |
| 2 | 2 |

 $\rightarrow 2\sqrt{3}$

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

Operations

with

Radicals

Clear Learning Target

You will be able to apply addition, subtraction, and multiplication to expressions with radicals.

Example #1: Simplify. $4\sqrt{5} + 2\sqrt{5}$

Before:

$$\begin{array}{c} 4x + 2x = 6x \\ \uparrow \quad \uparrow \\ \text{un} \quad \text{un} \end{array}$$

* to combine
radicals
must match!

Now:

$$\begin{array}{c} 4\sqrt{5} + 2\sqrt{5} = \boxed{6\sqrt{5}} \\ \uparrow \quad \uparrow \end{array}$$

You Try! Simplify. $9\sqrt{3} - 2\sqrt{3} = \boxed{7\sqrt{3}}$

\uparrow \uparrow
 $9\sqrt{3} - 2\sqrt{3}$

Example #2: Simplify. $2\sqrt{18} + 2\sqrt{32} + \sqrt{72}$

| | | |
|---|---|--|
| $\begin{array}{c} 18 \\ \wedge \\ 2 \cdot 9 \\ \wedge \\ \textcircled{3} \cdot 3 \end{array}$ | $\begin{array}{c} 32 \\ \wedge \\ 2 \cdot 16 \\ \wedge \\ 4 \cdot 4 \\ \wedge \\ \textcircled{2} \cdot \textcircled{2} \cdot \textcircled{2} \cdot \textcircled{2} \end{array}$ | $\begin{array}{c} 72 \\ \wedge \\ 9 \cdot 8 \\ \wedge \\ \textcircled{3} \cdot \textcircled{3} \cdot \textcircled{2} \cdot \textcircled{2} \\ \wedge \\ \textcircled{2} \cdot \textcircled{2} \cdot \textcircled{2} \cdot \textcircled{2} \end{array}$ |
| $2 \cdot 3\sqrt{2}$ | $2 \cdot 2 \cdot 2\sqrt{2}$ | $3 \cdot 2\sqrt{2}$ |
| \downarrow | \downarrow | \downarrow |
| $6\sqrt{2}$ | $8\sqrt{2}$ | $6\sqrt{2}$ |
| $6\sqrt{2} + 8\sqrt{2} + 6\sqrt{2} = \boxed{20\sqrt{2}}$ | | |

You Try! Simplify. $\sqrt{24} - \sqrt{54} + \sqrt{96}$

$$\begin{array}{r}
 24 \\
 \swarrow \searrow \\
 2 \quad 12 \\
 \quad \swarrow \searrow \\
 \quad 2 \quad 6 \\
 \quad \quad \swarrow \searrow \\
 \quad \quad 2 \quad 3 \\
 \hline
 2\sqrt{3 \cdot 2} \\
 \downarrow \\
 2\sqrt{6}
 \end{array}$$

$$\begin{array}{r}
 54 \\
 \swarrow \searrow \\
 27 \quad 2 \\
 \quad \swarrow \searrow \\
 \quad 9 \quad 3 \\
 \quad \quad \swarrow \searrow \\
 \quad \quad 3 \quad 3 \\
 \hline
 3\sqrt{3 \cdot 2} \\
 \boxed{3\sqrt{6}}
 \end{array}$$

$$\begin{array}{r}
 96 \\
 \swarrow \searrow \\
 24 \quad 8 \\
 \quad \swarrow \searrow \\
 \quad 6 \quad 4 \\
 \quad \quad \swarrow \searrow \\
 \quad \quad 2 \quad 2 \\
 \hline
 2 \cdot 2 = 4 \\
 4\sqrt{2 \cdot 3} = 6 \\
 \boxed{4\sqrt{6}}
 \end{array}$$

$$\begin{array}{r}
 2\sqrt{6} - 3\sqrt{6} + 4\sqrt{6} \\
 \hline
 -1\sqrt{6} + 4\sqrt{6} = \boxed{3\sqrt{6}}
 \end{array}$$

Example #3: Simplify. $3\sqrt{5}(2\sqrt{5} + 5\sqrt{3})$

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

$$6\sqrt{25} + 15\sqrt{15}$$

$$6 \cdot 5 + 15\sqrt{15}$$

$$\boxed{= 30 + 15\sqrt{15}}$$

$$\begin{array}{r}
 15 \\
 \swarrow \searrow \\
 5 \quad 3
 \end{array}$$

You Try! Simplify. $3\sqrt{2}(4\sqrt{3} + 6\sqrt{2})$

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

$$12\sqrt{6} + 18\sqrt{4}$$

$$12\sqrt{6} + 18 \cdot 2 = \boxed{12\sqrt{6} + 36}$$