

**10-3 Study Guide and Intervention****Operations with Radical Expressions**

**Add or Subtract Radical Expressions** When adding or subtracting radical expressions, use the Associative and Distributive Properties to simplify the expressions. If radical expressions are not in simplest form, simplify them.

**Example 1** Simplify  $10\sqrt{6} - 5\sqrt{3} + 6\sqrt{3} - 4\sqrt{6}$ .

$$\begin{aligned} 10\sqrt{6} - 5\sqrt{3} + 6\sqrt{3} - 4\sqrt{6} &= (10 - 4)\sqrt{6} + (-5 + 6)\sqrt{3} && \text{Associative and Distributive Properties} \\ &= 6\sqrt{6} + \sqrt{3} && \text{Simplify.} \end{aligned}$$

**Example 2** Simplify  $3\sqrt{12} + 5\sqrt{75}$ .

$$\begin{aligned} 3\sqrt{12} + 5\sqrt{75} &= 3\sqrt{2^2 \cdot 3} + 5\sqrt{5^2 \cdot 3} && \text{Factor 12 and 75.} \\ &= 3 \cdot 2\sqrt{3} + 5 \cdot 5\sqrt{3} && \text{Simplify.} \\ &= 6\sqrt{3} + 25\sqrt{3} && \text{Multiply.} \\ &= 31\sqrt{3} && \text{Distributive Property} \end{aligned}$$

**Exercises**

Simplify each expression.

1.  $2\sqrt{5} + 4\sqrt{5} \quad 6\sqrt{5}$

2.  $\sqrt{6} - 4\sqrt{6} \quad -3\sqrt{6}$

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

4.  $3\sqrt{75} + 2\sqrt{5} \quad 15\sqrt{3} + 2\sqrt{5}$

5.  $\sqrt{20} + 2\sqrt{5} - 3\sqrt{5} \quad \sqrt{5}$

6.  $2\sqrt{3} + \sqrt{6} - 5\sqrt{3} \quad -3\sqrt{3} + \sqrt{6}$

7.  $\sqrt{12} + 2\sqrt{3} - 5\sqrt{3} \quad -\sqrt{3}$

8.  $3\sqrt{6} + 3\sqrt{2} - \sqrt{50} + \sqrt{24} \quad 5\sqrt{6} - 2\sqrt{2}$

9.  $\sqrt{8a} - \sqrt{2a} + 5\sqrt{2a} \quad 6\sqrt{2a}$

10.  $\sqrt{54} + \sqrt{24} \quad 5\sqrt{6}$

11.  $\sqrt{3} + \sqrt{\frac{1}{3}} \quad \frac{4\sqrt{3}}{3}$

12.  $\sqrt{12} + \sqrt{\frac{1}{3}} \quad \frac{7\sqrt{3}}{3}$

13.  $\sqrt{54} - \sqrt{\frac{1}{6}} \quad \frac{17\sqrt{6}}{6}$

14.  $\sqrt{80} - \sqrt{20} + \sqrt{180} \quad 8\sqrt{5}$

15.  $\sqrt{50} + \sqrt{18} - \sqrt{75} + \sqrt{27} \quad 8\sqrt{2} - 2\sqrt{3}$

16.  $2\sqrt{3} - 4\sqrt{45} + 2\sqrt{\frac{1}{3}} \quad \frac{8\sqrt{3}}{3} - 12\sqrt{5}$

17.  $\sqrt{125} - 2\sqrt{\frac{1}{5}} + \sqrt{\frac{1}{3}} \quad \frac{23\sqrt{5}}{5} + \frac{\sqrt{3}}{3}$

18.  $\sqrt{\frac{2}{3}} + 3\sqrt{3} - 4\sqrt{\frac{1}{12}} \quad \frac{\sqrt{6} + 7\sqrt{3}}{3}$

**10-3 Study Guide and Intervention** *(continued)***Operations with Radical Expressions**

**Multiply Radical Expressions** Multiplying two radical expressions with different radicands is similar to multiplying binomials.

**Example** Multiply  $(3\sqrt{2} - 2\sqrt{5})(4\sqrt{20} + \sqrt{8})$ .

Use the FOIL method.

$$\begin{aligned} (3\sqrt{2} - 2\sqrt{5})(4\sqrt{20} + \sqrt{8}) &= (3\sqrt{2})(4\sqrt{20}) + (3\sqrt{2})(\sqrt{8}) + (-2\sqrt{5})(4\sqrt{20}) + (-2\sqrt{5})(\sqrt{8}) \\ &= 12\sqrt{40} + 3\sqrt{16} - 8\sqrt{100} - 2\sqrt{40} && \text{Multiply.} \\ &= 12\sqrt{2^2 \cdot 10} + 3 \cdot 4 - 8 \cdot 10 - 2\sqrt{2^2 \cdot 10} && \text{Simplify.} \\ &= 24\sqrt{10} + 12 - 80 - 4\sqrt{10} && \text{Simplify.} \\ &= 20\sqrt{10} - 68 && \text{Combine like terms.} \end{aligned}$$

**Exercises**

Simplify each expression.

1.  $2(\sqrt{3} + 4\sqrt{5}) \quad 2\sqrt{3} + 8\sqrt{5}$

2.  $\sqrt{6}(\sqrt{3} - 2\sqrt{6}) \quad 3\sqrt{2} - 12$

3.  $\sqrt{5}(\sqrt{5} - \sqrt{2}) \quad 5 - \sqrt{10}$

4.  $\sqrt{2}(3\sqrt{7} + 2\sqrt{5}) \quad 3\sqrt{14} + 2\sqrt{10}$

5.  $(2 - 4\sqrt{2})(2 + 4\sqrt{2}) \quad -28$

6.  $(3 + \sqrt{6})^2 \quad 15 + 6\sqrt{6}$

7.  $(2 - 2\sqrt{5})^2 \quad 24 - 8\sqrt{5}$

8.  $3\sqrt{2}(\sqrt{8} + \sqrt{24}) \quad 12 + 12\sqrt{3}$

9.  $\sqrt{8}(\sqrt{2} + 5\sqrt{8}) \quad 44$

10.  $(\sqrt{5} - 3\sqrt{2})(\sqrt{5} + 3\sqrt{2}) \quad -13$

11.  $(\sqrt{3} + \sqrt{6})^2 \quad 9 + 6\sqrt{2}$

12.  $(\sqrt{2} - 2\sqrt{3})^2 \quad 14 - 4\sqrt{6}$

13.  $\frac{(\sqrt{5} - \sqrt{2})(\sqrt{2} + \sqrt{6})}{\sqrt{10} - 2 + \sqrt{30} - 2\sqrt{3}}$

14.  $\frac{(\sqrt{8} - \sqrt{2})(\sqrt{3} + \sqrt{6})}{\sqrt{6} + 2\sqrt{3}}$

15.  $\frac{(\sqrt{5} - \sqrt{18})(7\sqrt{5} + \sqrt{3})}{35 + \sqrt{15} - 21\sqrt{10} - 3\sqrt{6}}$

16.  $\frac{(2\sqrt{3} - \sqrt{45})(\sqrt{12} + 2\sqrt{6})}{12 - 6\sqrt{15} + 12\sqrt{2} - 6\sqrt{30}}$

17.  $\frac{(2\sqrt{5} - 2\sqrt{3})(\sqrt{10} + \sqrt{6})}{4\sqrt{2}}$

18.  $\frac{(\sqrt{2} + 3\sqrt{3})(\sqrt{12} - 4\sqrt{8})}{2 - 22\sqrt{6}}$