

## 11-8 Adding and Subtracting Radicals

**Objective:** To simplify sums and differences of radicals.

**Example 1** Simplify: a.  $3\sqrt{5} + 4\sqrt{5}$  b.  $2\sqrt{7} + 3\sqrt{5}$

**Solution** a. Terms with common factors can be combined.

$$3\sqrt{5} + 4\sqrt{5} = (3 + 4)\sqrt{5} = 7\sqrt{5}$$

b. Terms that have unlike radicals cannot be combined.

Therefore  $2\sqrt{7} + 3\sqrt{5}$  is in simplest form.

**Simplify.**

1.  $6\sqrt{2} - 3\sqrt{2}$

2.  $8\sqrt{3} + 4\sqrt{3}$

3.  $2\sqrt{15} - \sqrt{13}$

4.  $-5\sqrt{2} + 8\sqrt{2}$

5.  $4\sqrt{5} + 3\sqrt{7}$

6.  $9\sqrt{3} - 4\sqrt{3}$

7.  $7\sqrt{5} + 6\sqrt{5}$

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

9.  $-3\sqrt{10} + 7\sqrt{6}$

**Example 2** Simplify  $4\sqrt{3} - 2\sqrt{7} + 8\sqrt{3}$ .

**Solution** Use the distributive property to regroup.

$$\begin{aligned} 4\sqrt{3} - 2\sqrt{7} + 8\sqrt{3} &= (4 + 8)\sqrt{3} - 2\sqrt{7} \\ &= 12\sqrt{3} - 2\sqrt{7} \end{aligned}$$

**Simplify.**

10.  $10\sqrt{6} - 3\sqrt{6} + \sqrt{6}$

11.  $7\sqrt{2} + 6\sqrt{2} - 3\sqrt{2}$

12.  $15\sqrt{7} + 2\sqrt{7} - 10\sqrt{7}$

13.  $2\sqrt{3} + 5\sqrt{2} + 8\sqrt{3}$

14.  $8\sqrt{6} - \sqrt{3} + \sqrt{6} - 3\sqrt{3}$

15.  $2\sqrt{5} - 5\sqrt{2} + 9\sqrt{2} - 6\sqrt{5}$

16.  $2\sqrt{6} - \sqrt{10} + 4\sqrt{6}$

17.  $3\sqrt{5} + \sqrt{11} - 4\sqrt{11} + \sqrt{5}$

18.  $6\sqrt{3} - \sqrt{7} + 8\sqrt{3} - 6\sqrt{7}$

19.  $5\sqrt{13} - 3\sqrt{2} + 2\sqrt{13} - 8\sqrt{2}$

**Example 3** Simplify  $5\sqrt{2} - 3\sqrt{6} + 2\sqrt{8} - 5\sqrt{54}$ .

**Solution** First express each radical in simplest form.

$$\begin{aligned} 5\sqrt{2} - 3\sqrt{6} + 2\sqrt{8} - 5\sqrt{54} &= 5\sqrt{2} - 3\sqrt{6} + 2\sqrt{4 \cdot 2} - 5\sqrt{9 \cdot 6} \\ &= 5\sqrt{2} - 3\sqrt{6} + 2(2\sqrt{2}) - 5(3\sqrt{6}) \\ &= 5\sqrt{2} - 3\sqrt{6} + 4\sqrt{2} - 15\sqrt{6} \\ &= 9\sqrt{2} - 18\sqrt{6} \end{aligned}$$

**11-8 Adding and Subtracting Radicals (continued)****Simplify.**

20.  $3\sqrt{2} + 3\sqrt{50}$

21.  $3\sqrt{24} - 2\sqrt{6}$

22.  $5\sqrt{63} - 2\sqrt{28}$

23.  $5\sqrt{18} - 7\sqrt{72}$

24.  $2\sqrt{80} - 6\sqrt{45}$

25.  $5\sqrt{48} - 6\sqrt{27}$

26.  $4\sqrt{2} + \sqrt{72}$

27.  $\sqrt{108} - \sqrt{27}$

28.  $3\sqrt{8} - 2\sqrt{50}$

29.  $5\sqrt{12} - 3\sqrt{48}$

30.  $\sqrt{32} - \sqrt{50}$

31.  $\sqrt{98} - \sqrt{72}$

32.  $4\sqrt{72} - 6\sqrt{32}$

33.  $2\sqrt{75} + 3\sqrt{108}$

34.  $10\sqrt{18} - 5\sqrt{32}$

35.  $2\sqrt{2} + 3\sqrt{8} + \sqrt{32}$

36.  $5\sqrt{28} + 3\sqrt{112}$

37.  $4\sqrt{54} - 2\sqrt{6}$

38.  $8\sqrt{8} - 4\sqrt{32} + 3\sqrt{2}$

39.  $2\sqrt{27} - \sqrt{75} - \sqrt{3}$

40.  $4\sqrt{75} - 3\sqrt{48} - \sqrt{27}$

41.  $2\sqrt{45} - 5\sqrt{20} + 2\sqrt{5}$

**Mixed Review Exercises****Write each equation in slope-intercept form.**

1.  $2y = 4x + 6$

2.  $3y - x + 9 = 0$

3.  $2x - y = 2$

4.  $3x + 3y = 2$

5.  $x = 2y + 10$

6.  $2x - 5y = 0$

7.  $x = -y + 7$

8.  $4 - x + 2y = 0$

9.  $6x - 9 = 3y$

10.  $8y + 12 = 4x$

**For each parabola whose equation is given, find the coordinates of the vertex and the equation of the axis of symmetry.**

11.  $y = -2x^2$

12.  $y = x^2 - 4x + 4$

13.  $y = 3 - 2x^2$

14.  $y = -x^2 - 4x$

**Solve. Assume that no denominator equals zero.**

15.  $\frac{x-3}{8} = \frac{x}{5}$

16.  $\frac{2}{x+4} = \frac{-1}{2x+3}$

17.  $9 - \frac{8}{x} = x$

18.  $\frac{1}{x} = \frac{2x}{x+1}$

19.  $\frac{2}{x+1} + \frac{1}{x-1} = 1$

20.  $\frac{x+1}{x+4} - \frac{1}{8} = \frac{x-3}{x}$