

**9-3 Study Guide and Intervention** *(continued)***Properties of Logarithms**

**Solve Logarithmic Equations** You can use the properties of logarithms to solve equations involving logarithms.

**Example** Solve each equation.

a.  $2 \log_3 x - \log_3 4 = \log_3 25$

$$2 \log_3 x - \log_3 4 = \log_3 25 \quad \text{Original equation}$$

$$\log_3 x^2 - \log_3 4 = \log_3 25 \quad \text{Power Property}$$

$$\log_3 \frac{x^2}{4} = \log_3 25 \quad \text{Quotient Property}$$

$$\frac{x^2}{4} = 25 \quad \text{Property of Equality for Logarithmic Functions}$$

$$x^2 = 100 \quad \text{Multiply each side by 4.}$$

$$x = \pm 10 \quad \text{Take the square root of each side.}$$

Since logarithms are undefined for  $x < 0$ ,  $-10$  is an extraneous solution. The only solution is 10.

b.  $\log_2 x + \log_2 (x + 2) = 3$

$$\log_2 x + \log_2 (x + 2) = 3 \quad \text{Original equation}$$

$$\log_2 x(x + 2) = 3 \quad \text{Product Property}$$

$$x(x + 2) = 2^3 \quad \text{Definition of logarithm}$$

$$x^2 + 2x = 8 \quad \text{Distributive Property}$$

$$x^2 + 2x - 8 = 0 \quad \text{Subtract 8 from each side.}$$

$$(x + 4)(x - 2) = 0 \quad \text{Factor.}$$

$$x = 2 \text{ or } x = -4 \quad \text{Zero Product Property}$$

Since logarithms are undefined for  $x < 0$ ,  $-4$  is an extraneous solution. The only solution is 2.

**Exercises**

Solve each equation. Check your solutions.

1.  $\log_5 4 + \log_5 2x = \log_5 24$

2.  $3 \log_4 6 - \log_4 8 = \log_4 x$

3.  $\frac{1}{2} \log_6 25 + \log_6 x = \log_6 20$

4.  $\log_2 4 - \log_2 (x + 3) = \log_2 8$

5.  $\log_6 2x - \log_6 3 = \log_6 (x - 1)$

6.  $2 \log_4 (x + 1) = \log_4 (11 - x)$

7.  $\log_2 x - 3 \log_2 5 = 2 \log_2 10$

8.  $3 \log_2 x - 2 \log_2 5x = 2$

9.  $\log_3 (c + 3) - \log_3 (4c - 1) = \log_3 5$

10.  $\log_5 (x + 3) - \log_5 (2x - 1) = 2$