Communicate

1. Given that $\log_{10} 5 \approx 0.6990$, explain how to approximate the values of $\log_{10} 0.005$ and $\log_{10} 500$.
2. Explain how to write an expression such as $\log_7 32 - \log_7 4$ as a single logarithm.
3. Explain how to evaluate $4^{\log_4 8}$ and $\log_2 2^7$. Include the names of the properties you would use.
4. Explain why you must check your answers when solving an equation such as $\log_2 3x = \log_2(x + 4)$ for x.

Guided Skills Practice

Given $\log_3 7 \approx 1.7712$, approximate the value for each logarithm by using the Product and Quotient Properties of Logarithms. *(EXAMPLE 1)*

5. $\log_3 49$
6. $\log_3 \frac{3}{7}$

Write each expression as a single logarithm. Then simplify, if possible. *(EXAMPLE 2)*

7. $\log_3 x - \log_3 y + \log_3 z$
8. $\log_2 3 + \log_2 6 - \log_2 10$

Evaluate each expression. *(EXAMPLES 3 AND 4)*

9. $\log_4 16^8$
10. $3^{\log_3 12}$
11. $\log_7 7^3$
12. Solve $\log_3 x = \log_3(2x - 4)$ for x, and check your answers. *(EXAMPLE 5)*

Write each expression as a sum or difference of logarithms. Then simplify, if possible.

13. $\log_8(5 \cdot 8)$ **14.** $\log_2 8xy$ **15.** $\log_3 \frac{x}{9}$ **16.** $\log_4 \frac{x}{32}$

Use the values given below to approximate the value of each logarithmic expression in Exercises 17–28.

$\log_2 7 = 2.8074$	$\log_2 5 = 2.3219$	$\log_4 5 = 1.1610$
$\log_4 3 \approx 0.7925$	$\log_2 3 \approx 1.5850$	$\log_{10} 8.3 \approx 0.9191$

17. $\log_4 15$ **18.** $\log_2 35$ **19.** $\log_2 28$

20. $\log_4 12$ **21.** $\log_4 60$ **22.** $\log_2 105$

23. $\log_{10} 830$ **24.** $\log_{10} 0.0083$ **25.** $\log_4 \frac{3}{5}$

26. $\log_2 \frac{7}{10}$ **27.** $\log_4 \frac{5}{4}$ **28.** $\log_2 \frac{2}{7}$

Write each expression as a single logarithm. Then simplify, if possible.

29. $\log_2 5 + \log_2 7$ **30.** $\log_4 8 + \log_4 2$

31. $\log_3 45 - \log_3 9$ **32.** $\log_2 14 - \log_2 7$

33. $\log_2 5 + \log_2 x - \log_2 10$ **34.** $\log_3 x + \log_3 4 - \log_3 2$

35. $\log_7 3x - \log_7 9x + \log_7 6y$ **36.** $\log_5 6s - \log_5 s + \log_5 4t$

37. $5 \log_2 m - 2 \log_2 n$ **38.** $7 \log_3 y - 4 \log_3 x$

39. $4 \log_b m + \frac{1}{2} \log_b n - 3 \log_b 2p$ **40.** $\frac{1}{2} \log_b 3c + \frac{1}{2} \log_b 4d - 2 \log_b 5e$

41. $1 - 2 \log_7 x$ **42.** $2 + 4 \log_3 x$

Evaluate each expression.

43. $3^{\log_3 8}$ **44.** $9^{\log_9 2}$ **45.** $\log_4 4^5$

46. $\log_{10} 10^2$ **47.** $7^{\log_7 9} + \log_2 8$ **48.** $5^{\log_5 7} + \log_3 9$

49. $\log_9 9^{11} - \log_4 64$ **50.** $\log_3 3^5 + \log_5 125$ **51.** $6^{\log_6 3} - \log_5 \frac{1}{25}$

52. $2^{\log_2 3} + \log_6 \frac{1}{36}$ **53.** $\log_3 \frac{1}{9} - 2^{\log_2 3}$ **54.** $\log_2 \frac{1}{8} - 4^{\log_4 7}$

Solve for *x*, and check your answers. Justify each step in the solution process.

55. $\log_2 7x = \log_2(x^2 + 12)$ **56.** $\log_5(3x^2 - 1) = \log_5 2x$

57. $\log_b(x^2 - 15) = \log_b(6x + 1)$ **58.** $\log_{10}(5x - 3) - \log_{10}(x^2 + 1) = 0$

59. $2 \log_a x + \log_a 2 = \log_a(5x + 3)$ **60.** $\log_b(x^2 - 2) + 2 \log_b 6 = \log_b 6x$

61. $2 \log_3 x + \log_3 5 = \log_3(14x + 3)$ **62.** $\log_5 2 + 2 \log_5 t = \log_5(3 - t)$

State whether each equation is always true, sometimes true, or never true. Assume that *x* is a positive real number.

63. $\log_3 9 = 2 \log_3 3$ **64.** $\log_2 8 - \log_2 2 = 2$ **65.** $\log x^2 = 2 \log x$

66. $\log x - \log 5 = \log \frac{x}{5}$ **67.** $\frac{\log 3}{\log x} = \log 3 - \log x$ **68.** $\log(x - 2) = \frac{\log x}{\log 2}$

69. $\frac{1}{2} \log x = \log \sqrt{x}$ **70.** $\log 12x = 12 \log x$ **71.** $\log_3 x + \log_3 x = \log_3 2x$