

Practice and Apply

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.

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

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. $\log_3 x + \log_3 x = \log_3 2x$