Answers for 7.5

For use with pages 510–513

7.5 Skill Practice

1. product

2. Use common logarithms in the change of base formula, or use natural logarithms in the change of base formula.

3. B **4.** D **5.** A **6.** C

7. 0.477 **8.** 1.681

9. 1.204 **10.** 1.806

11. 2.158 **12.** -0.477

13. -0.602 **14.** -1.079

15. $\log_3 4 + \log_3 x$

16. $\ln 15 + \ln x$

17. $\log 3 + 4 \log x$

18. $5 \log_5 x$

19. $\log_2 2 - \log_2 5$

20. $\ln 12 - \ln 5$

21. $\log_4 x - (\log_4 3 + \log_4 y)$

22. $\ln 4 + 2 \ln x + \ln y$

23. $\log_7 5 + 3 \log_7 x + \log_7 y + 2 \log_7 z$

24. $\log_6 36 + 2 \log_6 x$

25. $2 \ln x + \frac{1}{3} \ln y$

26. $\log 10 + 3 \log x$

27. $\frac{1}{2} \log_2 x$

28. $\ln 6 + 2 \ln x - 4 \ln y$

29. $\frac{3}{4} \ln x$

30. $\frac{1}{2}(\log_3 9 + \log_3 x)$

31. The two parts should be added, not multiplied; $\log_2 5 + \log_2 x$.

32. The power of 3 is attached to the x, not the 8; $\ln 8 + 3 \ln x$.

33. $\log_4 \frac{7}{10}$ **34.** $\ln 3$

35. $\log 11x^2$ **36.** $\ln x^6 y^4$

37. $\log \frac{x^5}{y^4}$ **38.** $\log_4 32x^7 y^4$

39. $\ln 10x$ **40.** $\log_3 4\sqrt[3]{x}$

41. $\ln \frac{64}{y^4}$ **42.** $\log_3 50$

43. C **44.** D

45. about 1.404 **46.** about 1.594

47. about 2.465 **48.** about 1.486

49. about 1.631 **50.** about 1.640

51. about 1.581 **52.** about 4.807

53. about 1.513 **54.** about 2.792

55. 1.5 **56.** about 1.667

57. about 0.875 **58.** about 1.100

59. about -1.358

60. about -0.860

61. When using the change of base formula, the base goes in the denominator; $\frac{\log 7}{\log 3}$.

62. a. Barking dog: $I = 10^{-4}$ W/m^2, 80 decibels

b. Ambulance siren: $I = 10^{0}$ W/m^2, 120 decibels

c. Bee: $I = 10^{-6.5}$ W/m^2, 55 decibels

63. 150 decibels

64. a. *Sample answer:* $M = 5$, $N = 6$, $b = 3$, $2.183 \neq 1.465 + 1.631$

b. *Sample answer:* $M = 6$, $N = 5$, $b = 3$, $0 \neq 1.631 - 1.465$

65. Let $x = \log_b m$ and $y = \log_b n$, convert these to exponential form to get $m = b^x$ and $n = b^y$. Then $mn = b^x b^y$; $mn = b^{x+y}$. Convert this to logarithmic form to get $\log_b (mn) = x + y$. Use substitution to get $\log_b (mn) = \log_b m + \log_b n$.

66. Let $x = \log_b m$ and $y = \log_b n$. Convert these to exponential form and you get $m = b^x$ and $n = b^y$. Then $\frac{m}{n} = \frac{b^x}{b^y}$ which simplifies to b^{x-y}. Convert this to logarithmic form and you get $\log_b \left(\frac{m}{n}\right) = x - y$. Use substitution to get $\log_b \left(\frac{m}{n}\right) = \log_b m - \log_b n$.

67. Let $x = \log_b m$, convert this to exponential form, and you have $m = b^x$ and then $m^n = b^{nx}$. When you convert this to logarithmic form, you have $\log_b m^n = nx$. Use substitution to get $\log_b m^n = n \log_b m$.

68. Let $x = \log_b a$, $y = \log_b c$, and $z = \log_c a$. Convert these to exponential form to get $a = b^x$, $c = b^y$, $a = c^z$. Since $a = b^x$ and $a = c^z$, then $b^x = c^z$. Then take the log of both sides, to end up with $\log_b b^x = \log_b c^z$. This simplifies to $x \log_b b = z \log_b c$. Since $\log_b b = 1$ and $\log_b c = y$, use substitution to get $x = yz$. Then solve for z and the result is $z = \frac{x}{y}$, and by substitution, $\log_c a = \frac{\log_b a}{\log_b c}$.

7.5 Problem Solving

69. about 56 decibels

70. about 92 decibels

71. 10; $L(10I) - L(I)$

$$= 10 \log \frac{10I}{I_0} - 10 \log \frac{I}{I_0}$$

$$= 10\left(\log \frac{10I}{I_0} - \log \frac{I}{I_0}\right)$$

$$= 10\left(\log 10 + \log \frac{I}{I_0} - \log \frac{I}{I_0}\right)$$

$$= 10 \log 10$$

$$= 10(1) = 10$$

72. *Sample answer:* A blue whale can create sounds that are 60 decibels louder than those of a human.

73. a. $s = 2 \log_2 f$

b. *Sample answer:* The amount of light increases by about 1 each time.
about 1, 2, about 3, 4, about 5, 6, about 7, 8

c. About 22.627; if you set up the equation $9 = 2 \log_2 f$ and solve for f, the result is $2^{9/2}$.

74. a. about 1.386 knots

b. $s(h) = 2 \ln (100h)$

$$= 2 \log_e (100h)$$

$$= 2 \log_e 100 + 2 \log_e h$$

$$= 2 \frac{\log 100}{\log e} + 2 \frac{\log h}{\log e}$$

$$= 2 \frac{2}{\log e} + 2 \frac{\log h}{\log e}$$

$$= \frac{2}{\log e}(2 + \log h)$$

7.5 Mixed Review

75. $\begin{bmatrix} 11 & -1 \\ 10 & 1 \end{bmatrix}$ **76.** $\begin{bmatrix} 2 & -6 \\ 19 & 2 \end{bmatrix}$

77. $\begin{bmatrix} 5.1 & 7.2 & 20.4 \\ 27.6 & 15.9 & 21.6 \end{bmatrix}$

78. 37 **79.** -18 **80.** 10

81. 5 **82.** 5 **83.** 8

84. about 2981

85. about 0.00248

86. about 33.12

87. about 0.670

88. about 1.079

89. about 0.255

90. about 3.178

91. about 2.139