

## Communicate

1. Describe the relationship between logarithmic functions and exponential functions.
2. State the domain and range of logarithmic functions. How are they related to the domain and range of exponential functions?
3. Explain how to approximate the value of  $x$  in  $2^x = 58$  by using the table feature of a graphics calculator.

## Guided Skills Practice

4. Write  $4^2 = 16$  in logarithmic form. (EXAMPLE 1)
5. Write  $\log_5 25 = 2$  in exponential form. (EXAMPLE 1)

Solve each equation for  $x$ . Round your answers to the nearest thousandth. (EXAMPLE 2)

6.  $10^x = 568$

7.  $10^x = \frac{1}{500}$

Find the value of  $v$  in each equation. (EXAMPLE 3)

8.  $v = \log_7 49$

9.  $2 = \log_v 144$

10.  $2 = \log_4 v$

11. **CHEMISTRY** The pH of black coffee is 5. What is  $[H^+]$  for this coffee? (EXAMPLE 4)

## Practice and Apply

Write each equation in logarithmic form.

12.  $11^2 = 121$

13.  $5^4 = 625$

14.  $3^5 = 243$

15.  $6^3 = 216$

16.  $6^{-2} = \frac{1}{36}$

17.  $7^{-2} = \frac{1}{49}$

18.  $27^{\frac{1}{3}} = 3$

19.  $16^{\frac{1}{4}} = 2$

20.  $\left(\frac{1}{4}\right)^{-3} = 64$

21.  $\left(\frac{1}{9}\right)^{-2} = 81$

22.  $\left(\frac{1}{3}\right)^2 = \frac{1}{9}$

23.  $\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

Write each equation in exponential form.

24.  $\log_6 36 = 2$

25.  $\log_{10} 1000 = 3$

26.  $\log_{10} 0.001 = -3$

27.  $\log_{10} 0.1 = -1$

28.  $3 = \log_9 729$

29.  $3 = \log_7 343$

30.  $\log_3 \frac{1}{81} = -4$

31.  $\log_2 \frac{1}{32} = -5$

32.  $-2 = \log_2 \frac{1}{4}$

33.  $-3 = \log_3 \frac{1}{27}$

34.  $\log_{121} 11 = \frac{1}{2}$

35.  $\log_{144} 12 = \frac{1}{2}$

Find the approximate value of each logarithmic expression.

36.  $\log_{10} 1026$

37.  $\log_{10} 79$

38.  $\log_{10} 8$

39.  $\log_{10} 21,050$

40.  $\log_{10} 0.08$

41.  $\log_{10} 0.9$

42.  $\log_{10} 0.002$

43.  $\log_{10} 0.00013$

Solve each equation for  $x$ . Round your answers to the nearest hundredth.

44.  $10^x = 31$

45.  $10^x = 12$

46.  $10^x = 7210$

47.  $10^x = 3588$

48.  $10^x = 1.498$

49.  $10^x = 1.89$

50.  $10^x = 0.0054$

51.  $10^x = 0.035$

52.  $10^x = \frac{3}{49}$

53.  $10^x = \frac{1}{1085}$

54.  $10^x = \sqrt{7.4}$

55.  $10^x = \frac{1}{\sqrt{500}}$

Find the value of  $v$  in each equation.

56.  $v = \log_{10} 1000$

57.  $v = \log_4 64$

58.  $v = \log_7 343$

59.  $v = \log_{17} 289$

60.  $v = \log_3 3$

61.  $v = \log_7 7$

62.  $v = \log_{10} 0.001$

63.  $v = \log_{10} 0.01$

64.  $v = \log_2 \frac{1}{4}$

65.  $v = \log_{10} \frac{1}{100}$

66.  $v = \log_4 1$

67.  $v = \log_9 1$

68.  $3 = \log_6 v$

69.  $2 = \log_7 v$

70.  $1 = \log_5 v$

71.  $1 = \log_3 v$

72.  $\frac{1}{2} = \log_9 v$

73.  $\frac{1}{3} = \log_8 v$

74.  $-2 = \log_6 v$

75.  $-3 = \log_4 v$

76.  $0 = \log_{13} v$

77.  $0 = \log_2 v$

78.  $\log_v 16 = 2$

79.  $\log_v 125 = 3$

80.  $\log_v 9 = \frac{1}{2}$

81.  $\log_v 4 = \frac{1}{3}$

82.  $\log_v \frac{1}{16} = -4$

83.  $\log_v \frac{1}{8} = -3$

84.  $\log_v 216 = 3$

85.  $\log_v 243 = 5$

86. Graph  $f(x) = 3^x$  along with  $f^{-1}$ . Make a table of values that illustrates the relationship between  $f$  and  $f^{-1}$ .

87. Graph  $f(x) = 3^{-x}$  along with  $f^{-1}$ . Make a table of values that illustrates the relationship between  $f$  and  $f^{-1}$ .

Find the value of each expression.

88.  $\log_{27} \sqrt{3}$

89.  $\log_2 16\sqrt{2}$

90.  $\log_{\frac{1}{2}} 8$

**TRANSFORMATIONS** Let  $f(x) = \log_{10} x$ . For each function, identify the transformations from  $f$  to  $g$ .

91.  $g(x) = 3 \log_{10} x$

92.  $g(x) = -5 \log_{10} x$

93.  $g(x) = \frac{1}{2} \log_{10} x + 1$

94.  $g(x) = 0.25 \log_{10} x - 2$

95.  $g(x) = -\log_{10}(x - 2)$

96.  $g(x) = \log_{10}(x + 5) - 3$

**CHEMISTRY** Calculate  $[H^+]$  for each of the following:

97. household ammonia with a pH of about 10

98. distilled water with a pH of 7

99. human blood with a pH of about 7.4

100. **CHEMISTRY** How much greater is  $[H^+]$  for lemon juice, which has a pH of 2.1, than  $[H^+]$  for water, which has a pH of 7.0?