

LOGARITHMS

JAN 1997

- Change $r^s = t$ to logarithmic form.
 - $r = \log_s t$
 - $s = \log_t r$
 - $t = \log_r s$
 - $s = \log_r t$

- Evaluate: $\log_4 135$ (Accurate to 2 decimal places.)
 - 0.53
 - 1.53
 - 2.13
 - 3.54

- Determine the range of the function $y = 3^x + 2$.
 - $y > -2$
 - $y > 2$
 - $y > 0$
 - all real numbers

- Which expression is equivalent to $3 \log a + \log b - \frac{1}{2} \log c$?
 - $\log\left(\frac{6ab}{c}\right)$
 - $\log\left(\frac{a^3b}{\sqrt{c}}\right)$
 - $\log\left(3a + b - \frac{1}{2}c\right)$
 - $\log\left(\frac{a^3 + b}{\sqrt{c}}\right)$

- Solve: $\log_2 x - \log_2 4 = 3$
 - 2
 - 12
 - 32
 - 36

- If $\log_9 5 = x$ and $\log_{27} 2 = y$, express $\log_3 100$ in terms of x and y .
 - $2(9^x + 27^y)$
 - $9x + 27y$
 - $24xy$
 - $4x + 6y$

7. Given the function $f(x) = 7^{\frac{x}{2}} - 3$, determine its inverse, $f^{-1}(x)$.

- A. $f^{-1}(x) = 2 \log_7 x - 6$
- B. $f^{-1}(x) = 2 \log_7(x - 6)$
- C. $f^{-1}(x) = 2 \log_7(x + 3)$
- D. $f^{-1}(x) = 2 \log_7 x + 3$

8. The population of a city is increasing at a rate of 6.5% each year. If the present population is 12 000, how long will it take for the population to reach 32 000? (Accurate to at least 1 decimal place.)

JUN 1997

9. Change $\log_a b = c$ to exponential form.

- A. $b = a^c$
- B. $b = c^a$
- C. $c = a^b$
- D. $c = b^a$

11. Determine the inverse of $f(x) = x - 2$.

- A. $f^{-1}(x) = x + 2$
- B. $f^{-1}(x) = \frac{1}{x} - \frac{1}{2}$
- C. $f^{-1}(x) = -\frac{x}{2}$
- D. $f^{-1}(x) = \frac{1}{x-2}$

13. If $\log_a b = 0.5$, evaluate $\log_a \sqrt{b} + \log_a \left(\frac{a}{b}\right)$.

- A. 0.5
- B. 0.75
- C. 1
- D. 1.5

10. Evaluate: $\log_8 16$

- A. $\frac{1}{2}$
- B. $\frac{3}{4}$
- C. $\frac{4}{3}$
- D. 2

12. Solve: $2^{\log x} = \frac{1}{4}$

- A. -2
- B. $\frac{1}{100}$
- C. 2
- D. 100

14. Simplify: $\frac{1}{\log_a x} + \frac{1}{\log_b x}$

- A. $-\log_{ab} x$
- B. $-\log_x ab$
- C. $\log_{ab} x$
- D. $\log_x ab$

15. To the nearest power of 10, determine the difference between 10^{600} and 10^{200} .

- A. 10^3
- B. 10^{200}
- C. 10^{400}
- D. 10^{600}

16. Given $\log 6 = x$ and $\log 8 = y$, determine an expression for $\log 3$ in terms of x and y .

- A. $\frac{x}{3} - y$
- B. $x - \frac{y}{3}$
- C. $\frac{y}{3} - x$
- D. $y - \frac{x}{3}$

17. Solve for x : $2 \log(4 - x) - \log 3 = \log(10 - x)$

JAN 1998

18. Evaluate: $\log_3 3^{-15}$

- A. -15
- B. -5
- C. $\frac{1}{15}$
- D. $\frac{1}{5}$

20. Give the domain of the function $y = \log_2(x - 4)$.

- A. $x > -4$
- B. $x > 0$
- C. $x > 2$
- D. $x > 4$

22. Given $f(x) = \log_3 x$, determine its inverse, $f^{-1}(x)$.

- A. $f^{-1}(x) = x^3$
- B. $f^{-1}(x) = 3^x$
- C. $f^{-1}(x) = \log_x 3$
- D. $f^{-1}(x) = \log_3 \frac{1}{x}$

24. Consider the graph of $y = -\log_2 x$. Which value for x in the interval $a \leq x \leq b$, $a > 0$, will give the largest value for y ?

- A. a
- B. b
- C. $\frac{a+b}{2}$
- D. \sqrt{ab}

19. Which expression is equivalent to $2 \log \frac{3}{x}$?

- A. $\log 9 - 2 \log x$
- B. $\log 9 - \log x$
- C. $\log 6 - \log 2x$
- D. $(\log 3 - \log x)^2$

21. Solve: $\log_6 x + \log_6(x - 5) = 2$

- A. 3.5
- B. 8.5
- C. 9
- D. 20.5

23. Solve for x : $(\log_2 3)(\log_x 5)(\log_5 2) = 9$

- A. $3^{\frac{1}{9}}$
- B. $9^{\frac{1}{3}}$
- C. 2
- D. 3

~~25.~~ A river system has a current population of 4 000 000 fish. In each year, an enhancement program produces a 7% growth in population followed by a 200 000 fish harvest (i.e. 200 000 fish are taken from the population). Determine the number of fish after the second harvest.

26. Evaluate: $\log_2 8$

- A. 2
- B. 3
- C. 4
- D. 16

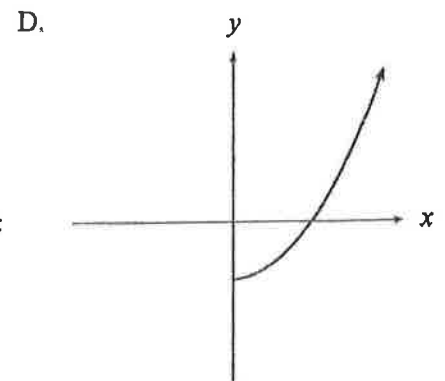
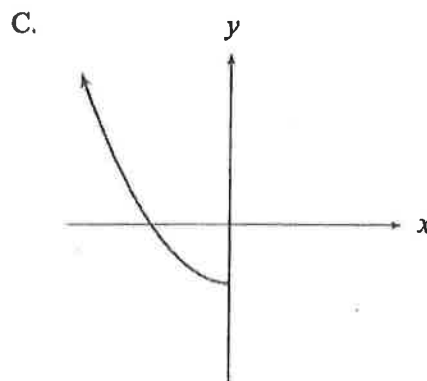
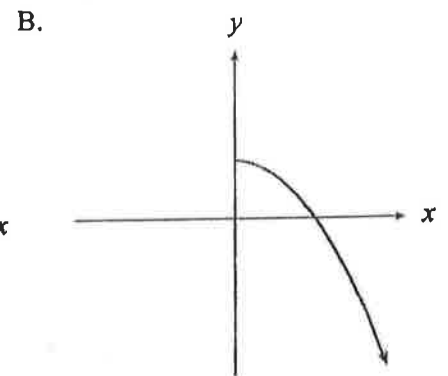
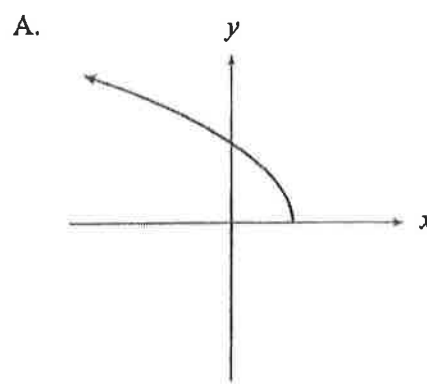
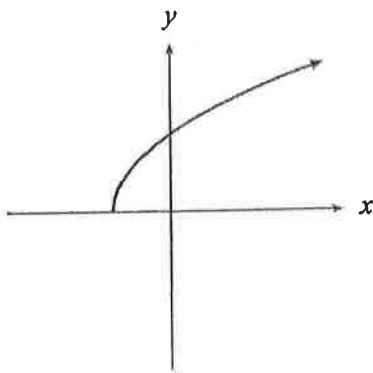
27. Which of the following is equivalent to $\log\left(\frac{a^3}{\sqrt{b}}\right)$?

- A. $3 \log a - \frac{1}{2} \log b$
- B. $\frac{3 \log a}{\frac{1}{2} \log b}$
- C. $\log 3a - \log \frac{1}{2} b$
- D. $\frac{\log 3a}{\log \frac{1}{2} b}$

28. Which of the following equations can be used to determine the number of years, t , that are needed for a \$300 deposit to increase to \$1 500 if it is invested at 9% compounded annually?

- A. $1\,500 = 300(1.09)^t$
- B. $300 = 1\,500(1.09)^t$
- C. $1\,500 = 300(1.9)^t$
- D. $300 = 1\,500(1.9)^t$

29. Which graph best represents the inverse relation of the graph shown below?



30. Determine the domain of the function $y = \log_3(x+1) - 2$.

- A. $x > -1$
- B. $x > 1$
- C. $y > -2$
- D. $y > 2$

31. Solve: $\frac{1}{\log_2 x} + \frac{1}{\log_8 x} = 2$

- A. 2
- B. 4
- C. 8
- D. 16

32. If $\log_3 7 = x$ and $\log_2 9 = y$, determine an expression for $\log_9 7 + \log_2 3$ in terms of x and y .

- A. $\frac{1}{2}x + \frac{1}{2}y$
- B. $2x + \frac{1}{2}y$
- C. $\frac{1}{2}x + \sqrt{y}$
- D. $2x + \sqrt{y}$

33. Solve: $\log(3x-5) + \log(2x-1) = 1$

JAN 1999

34. Evaluate: $\log_{12} 8000$

- A. 0.33
- B. 2.82
- C. 3.62
- D. 3.90

35. Express $3 \log a + \log b - \log c$ as a single logarithm.

- A. $\log\left(\frac{a^3 b}{c}\right)$
- B. $\log(a^3 + b - c)$
- C. $3 \log\left(\frac{ab}{c}\right)$
- D. $\log\left(\frac{3ab}{c}\right)$

36. The point $(-3, 2)$ is on the graph of the function $f(x)$. Which point must be on the graph of $f^{-1}(x)$, the inverse of $f(x)$?

- A. $(-2, 3)$
- B. $(2, -3)$
- C. $(3, -2)$
- D. $\left(-\frac{1}{3}, \frac{1}{2}\right)$

37. Determine the range of the function $y = 7^{x+2} - 4$.

- A. $y > -4$
- B. $y > -2$
- C. $y > 2$
- D. $y > 4$

38. Solve: $\log_3(2x+3) - \log_3(x+1) = 2$

- A. $-\frac{6}{7}$
- B. $-\frac{3}{4}$
- C. 0
- D. no real roots

39. Simplify: $8^{\log_2 6x}$

- A. $18x$
- B. $6x^3$
- C. $216x^3$
- D. $1296x^4$

40. Solve for x : $(\log_x 7)(\log_7 5) = 2$

- A. $\frac{5}{2}$
- B. $\sqrt{5}$
- C. $\frac{2\sqrt{3}}{7}$
- D. $\frac{\sqrt{35}}{7}$

41. A population of frogs doubles every 20 weeks. If the present population is 400 frogs, how long will it take for the population to reach 10 000?

JUN 1999

42. Change $y = \log_5 x$ to exponential form.

- A. $x = 5y$
- B. $x = 5^y$
- C. $x = y^5$
- D. $x = \left(\frac{1}{5}\right)^y$

43. Express $\log a - \log b + 2 \log c$ as a single logarithm.

- A. $\log \frac{ac^2}{b}$
- B. $\log \frac{a}{bc^2}$
- C. $\log \frac{ab}{2c}$
- D. $\log \frac{a}{2bc}$

44. Solve for x : $3^x = 18$

- A. $x = \log 6$
- B. $x = 3 \log 18$
- C. $x = \frac{\log 18}{\log 3}$
- D. $x = \log 18 - \log 3$

45. Determine an equation of the asymptote of the graph of $y = 4 \log_5(x - 4) + 5$.

- A. $x = 4$
- B. $x = 5$
- C. $y = 4$
- D. $y = 5$

46. Solve: $\log_2(4-x) - \log_2 x = 1$

- A. 1
- B. $\frac{4}{3}$
- C. $\frac{3}{2}$
- D. 2

47. Determine an expression equivalent to $\frac{1}{\log_a x} - \frac{1}{\log_b x}$.

- A. $\log_a x - \log_b x$
- B. $\log_x a - \log_x b$
- C. $\log_b x - \log_a x$
- D. $\log_x b - \log_x a$

48. The point (m, n) is on the graph of $f(x) = a^x$. Which of the following must be a point on the graph of $g(x) = \log_a x$ ($a > 0$)?

- A. $(-m, -n)$
- B. $(-n, -m)$
- C. (m, n)
- D. (n, m)

JAN 2000

49. Change $a = b^c$ to logarithmic form.

- A. $\log_a b = c$
- B. $\log_b c = a$
- C. $\log_c a = b$
- D. $\log_b a = c$

50. Solve for y : $x = \log c^y$

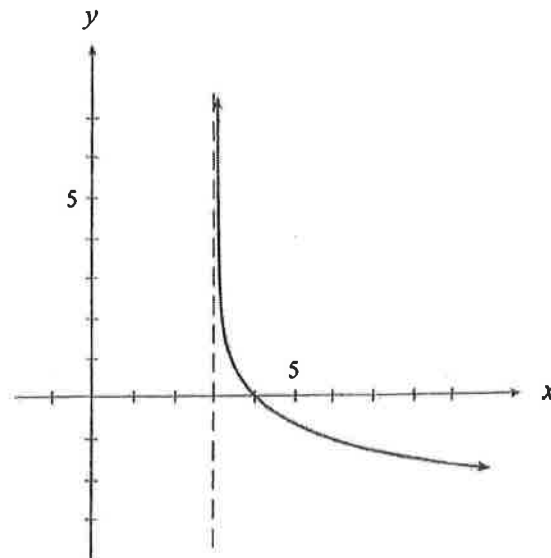
- A. $\frac{x}{\log c}$
- B. $\log c^x$
- C. $\frac{x}{c}$
- D. $x - \log c$

51. A population of insects doubles every 5 days. If there are currently 1 200 insects, determine an equation for the population, P , of insects t days from now.

- A. $P = 1\,200\left(\frac{1}{2}\right)^{\frac{t}{5}}$
- B. $P = 1\,200\left(\frac{1}{2}\right)^{5t}$
- C. $P = 1\,200(2)^{5t}$
- D. $P = 1\,200(2)^{\frac{t}{5}}$

52. Determine the equation of the logarithmic function graphed

- A. $y = \log_3(x - 3)$
- B. $y = \log_3(x + 3)$
- C. $y = -\log_3(x + 3)$
- D. $y = -\log_3(x - 3)$



53. Given $f(x) = 3x + 7$, determine $f^{-1}(x)$, the inverse of $f(x)$.

A. $f^{-1}(x) = 3x - 7$

B. $f^{-1}(x) = 3x - \frac{1}{7}$

C. $f^{-1}(x) = \frac{1}{3}x + \frac{1}{7}$

D. $f^{-1}(x) = \frac{1}{3}x - \frac{7}{3}$

54. Solve: $(\log_2 8)^x - (\log_9 3)^{x+1} = 0$

A. -0.50

B. -0.39

C. -0.33

D. 1.71

55. If $\log 5 = m$ and $\log 7 = n$, determine $\log \frac{35}{10}$ in terms of m and n .

A. $\frac{mn}{10}$

B. $\frac{m+n}{10}$

C. $m+n-1$

D. $m+n-10$

56. A population of wolves decreases by 2% each year. At the present time, there are 8 000 wolves. How long will it take for the population to become 500 wolves? (Answer to the nearest year.) (3 marks)

57. Given $\frac{1}{\log_y 4} = \log_{\frac{1}{4}} \frac{1}{8x}$, express y as a polynomial function of x . State the restrictions on x and y . (3 marks)

JUN 2000

58. Change $\log_a b = c$ to exponential form.

A. $b = a^c$

B. $b = c^a$

C. $a = b^c$

D. $a = c^b$

59. Evaluate: $\log 2^{2000}$

A. 0

B. 10.97

C. 602.06

D. infinitely large

60. What is the domain of $y = \log(x-a) + b$, if a and b are constants?

A. $x > a$

B. $x < a$

C. $x > b$

D. $x < b$

61. Solve: $\log_2(3-x) + \log_2 x = 1$

- A. 1
- B. 2
- C. 1, 2
- D. no solution

62. Solve for x : $3^{5x} = 8$

- A. $x = \frac{\log 8}{5 \log 3}$
- B. $x = \frac{\log 3}{5 \log 8}$
- C. $x = \frac{\log 8}{\log 3} - 5$
- D. $x = \frac{\log 3}{\log 8} - 5$

63. For which of the following functions is $f(x) = f^{-1}(x)$, where $f^{-1}(x)$ is the inverse function of $f(x)$?

- A. $f(x) = x^2$
- B. $f(x) = \frac{1}{x}$
- C. $f(x) = |x|$
- D. $f(x) = \log x$

64. If $\log_x 3 = a$ and $\log_x 49 = b$, express $\log_x \left(\frac{9}{7}\right)$ in terms of a and b .

- A. $\frac{a^2}{\sqrt{b}}$
- B. $a^2 - \sqrt{b}$
- C. $2a - \sqrt{b}$
- D. $2a - \frac{1}{2}b$

65. Solve for y and state all restrictions on x and y .

$$\frac{1}{\log_y 3} = \log_{\frac{1}{3}} 27 + 2 \log_3 x$$

JAN 2001

66. Solve for x : $\log_3 x = \log_3 5 + \log_3 7$

- A. 12
- B. 35
- C. $\log_3 12$
- D. $\log_3 35$

67. Express $\frac{1}{2} \log a - \log b$ as a single logarithm.

- A. $\log \frac{a}{2b}$
- B. $\log \frac{ab}{2}$
- C. $\log b\sqrt{a}$
- D. $\log \frac{\sqrt{a}}{b}$

68. Give the domain of the function $y = \log_4(x+7) - 3$.

- A. $x > -7$
- B. $x > -3$
- C. $x > 3$
- D. $x > 7$

69. If $f(x) = 3 \log x$, determine $f^{-1}(x)$, the inverse of $f(x)$.

- A. $f^{-1}(x) = \frac{1}{3 \log x}$
- B. $f^{-1}(x) = \frac{1}{3} \log \frac{1}{x}$
- C. $f^{-1}(x) = 10^{\frac{x}{3}}$
- D. $f^{-1}(x) = 10^{x-3}$

70. A culture has 300 bacteria. The number of bacteria doubles every 4 hours. How long will it take for the number of bacteria to reach 72 000 ?

- A. 31.63 hours
- B. 33.27 hours
- C. 36.88 hours
- D. 60 hours



Determine the number of solutions for the following system:

$$y = -4 \log_{12} x$$

$$y = 4 \sin x$$

- A. 2
- B. 3
- C. 4
- D. 5

72. Simplify: $2^{\log_8 x^{27}}$

- A. $3x$
- B. $9x$
- C. x^3
- D. x^9

JUN 2001

73. Change $b^a = c$ to logarithmic form.

- A. $\log_b a = c$
- B. $\log_c b = a$
- C. $\log_b c = a$
- D. $\log_c a = b$

74. In which line would the graph of a function $f(x)$ be reflected to obtain the graph of $f^{-1}(x)$, the inverse of $f(x)$?

- A. $y = 0$
- B. $x = 0$
- C. $y = -x$
- D. $y = x$

75. Express $2 \log k + \log 5 - \log p$ as a single logarithm.

- A. $\log \frac{5k^2}{p}$
- B. $\log \frac{10k}{p}$
- C. $\log(k^2 + 5 - p)$
- D. $\log(2k + 5 - p)$

76. Solve: $\log_2 x + \log_2(x - 2) = 3$

- A. 2.5
- B. 3
- C. 4
- D. $1 + \sqrt{7}$

77. The population of a type of bacteria triples every 20 hours. In how many hours will a population of 30 become a population of 1 000 ?

- A. 63.84
- B. 101.18
- C. 106.83
- D. 169.32

78. Determine the domain of the function $y = \log_{2x-3}(x)$.

- A. $x > 0, x \neq 1$
- B. $x > 0, x \neq 2$
- C. $x > \frac{3}{2}, x \neq 1$
- D. $x > \frac{3}{2}, x \neq 2$

79. Solve for x : $\log_a a^{2x} = \log_{b^2} b^{3x-3}$

- A. -3
- B. $-\frac{3}{2}$
- C. $\frac{3}{2}$
- D. 3

80. Simplify: $\log_{\frac{1}{x}} \frac{1}{y} - \log_{\frac{1}{x}} y - \log_x \frac{1}{y}$

- A. $\log_x y^3$
- B. $\log_x y$
- C. $-\log_x y$
- D. $\log_x y - 2$

SPECS 2001

81. The population of ABC high school is currently 1 250 students and is decreasing at an annual rate of 3%. Which expression represents the population, P , of the school 5 years from now?
- A. $P = 1\,250(1.03)^5$
 - B. $P = 1\,250(1.03)^{-5}$
 - C. $P = 1\,250(0.97)^5$
 - D. $P = 1\,250(0.97)^{-5}$
82. Graph $\log_5(y + 2) = x + 1$ on the grid below. State any asymptotes and give exact values for the x - and y -intercepts.
83. The half-life of plutonium-239 is about 25 000 years. How many years does it take until only 36% of the plutonium still remains?

SAMPLE 2001

84. A recent earthquake in Washington measured 6.3 on the Richter scale. In 1964, the Alaskan earthquake measured 8.5. How many times as intense was the 1964 Alaskan earthquake compared to the recent Washington earthquake?
- A. 1.35
 - B. 2.2
 - C. $10^{1.35}$
 - D. $10^{2.2}$
85. Solve for x : $\log_3(x - 6) + \log_3 x = 3$
- A. 4.5
 - B. 9
 - C. 16.5
 - D. -3, 9

86. A bank account earns interest at a rate of 7% per year compounded continuously. Which equation will determine the effective annual growth rate, r ? (P_0 is the initial amount invested; t is time, in years, over which the amount is invested.)

A. $P_0(1+r)^t = P_0e^{0.07t}$

B. $P_0(1.07)^t = P_0e^{rt}$

C. $P_0(1+r)^t = P_0e^{1.07t}$

D. $P_0(1.07)^t = P_0^{(1+r)t}$

87. If 3150 mg of a radioactive substance decays to 450 mg in 73 weeks, determine the half-life of the substance to the nearest week. (Solve algebraically using logarithms.)

JAN 2002

88. Change to logarithmic form: $p = q^r$

A. $\log_p q = r$

B. $\log_q p = r$

C. $\log_r p = q$

D. $\log_q r = p$

89. Evaluate: $\log_2 7.5$

A. 0.44

B. 0.57

C. 2.26

D. 2.91

90. Determine the range of the function $y = 2^{x-3} + 4$.

A. $y > 4$

B. $y > -4$

C. $x > 3$

D. $x > -3$

91. Solve: $16^{x+1} = 8^{1-x}$

A. $-\frac{1}{3}$

B. $-\frac{1}{7}$

C. $\frac{2}{7}$

D. $\frac{2}{5}$

92. Which expression is equivalent to $\log\left(\frac{100x^3}{y}\right)$?

A. $2 + \log(3x - y)$

B. $300 \log x - \log y$

C. $2 + 3 \log x - \log y$

D. $\log(100 + x^3 - y)$

93. Solve: $\log_3(x+4) + \log_3(6-x) = 2$

A. 3

B. 5

C. 3, -5

D. 5, -3

94. Simplify: $a^{\log_a 8 + \log_a 2}$

A. 10

B. 16

C. a^{10}

D. a^{16}

95. The population of a city grows continuously according to the formula $P = P_0 e^{kt}$. Determine the value of the growth rate, k , if the population increases from 30 000 to 45 000 in 8 years.

- A. 0.02
- B. 0.05
- C. 0.41
- D. 1.05

96. Strontium-90 is a radioactive substance with a half-life of 28 days. How many days will it take for a 200 gram sample of strontium-90 to be reduced to 8 grams? (Solve algebraically using logarithms.)

APR 2002

97. Change $y = \log_7 x$ to exponential form.

- A. $y = x^7$
- B. $y = 7^x$
- C. $x = y^7$
- D. $x = 7^y$

98. What is the domain of $y = \log_3(4x - 1) + 3$?

- A. $x > 0$
- B. $x > 1$
- C. $x > \frac{1}{4}$
- D. all real numbers

99. Simplify the expression: $\log_a\left(\frac{1}{a^b}\right)$

- A. $-b$
- B. b
- C. a^b
- D. a^{-b}

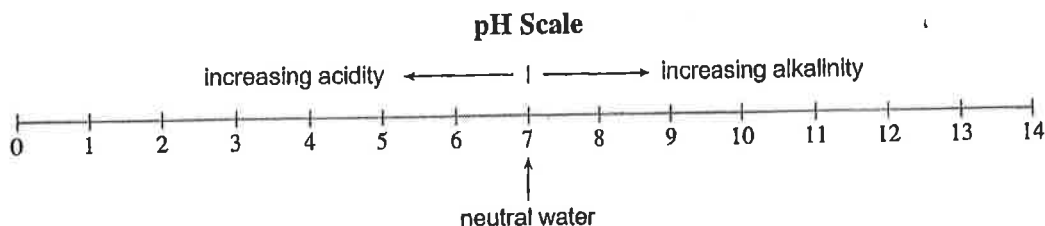
100. The intensity of light is reduced by 2% for each metre that a diver descends below the surface of the water. At what depth is the intensity of light only 10% of that at the surface?

- A. 5 m
- B. 18 m
- C. 98 m
- D. 114 m

101. Solve for x : $5^{x-1} = 125^{3-x}$

- A. 2
- B. 5
- C. $\frac{2}{5}$
- D. $\frac{5}{2}$

102. In chemistry, the pH scale measures the acidity (0–7) or alkalinity (7–14) of a solution. It is a logarithmic scale in base 10. Thus, a pH of 9 is 10 times more alkaline than a pH of 8. If a solution has a pH of 7.6, how many times more alkaline is it than neutral water which has a pH of 7?



- A. 0.6
 B. 1.09
 C. 3.98
 D. 12.18

103. Determine an expression for: $\sum_{n=1}^5 \log_a n$

- A. $\log_a 5$
 B. $\log_a 6$
 C. $\log_a 15$
 D. $\log_a 120$

104. At which of the following points is the relation $\log(y-x) + \log(y+x) = \log 9$ not defined?

- A. (0, 3)
 B. (-4, 5)
 C. (4, -5)
 D. (4, 5)

105. Solve algebraically.

$$\log_2(2-2x) + \log_2(1-x) = 5$$

106. A biologist determines that a particular type of bacteria grows continuously according to the formula $P = P_0 e^{kt}$. Determine the value of the continuous growth rate if the population of the bacteria increases from 500 to 1500 in 8 days.

JUN 2002

107. Determine the logarithmic form of $a = b^c$.

- A. $\log_a b = c$
 B. $\log_a c = b$
 C. $\log_c a = b$
 D. $\log_b a = c$

108. Solve: $\left(\frac{1}{4}\right)^{1-2x} = 8^{x-3}$

- A. -7
 B. $\frac{11}{7}$
 C. $\frac{7}{4}$
 D. no solution

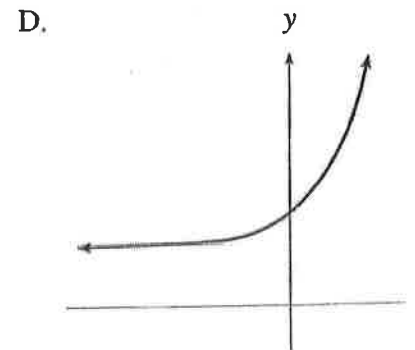
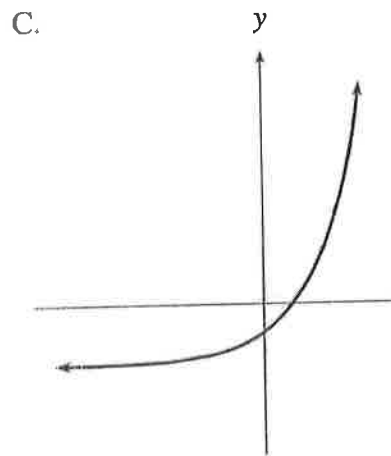
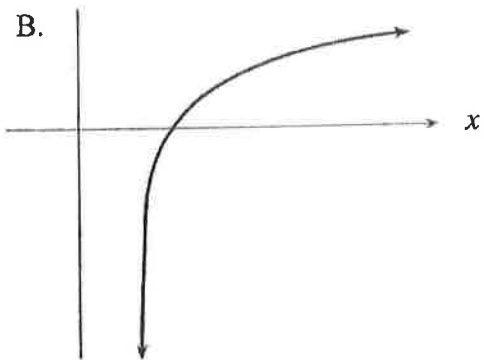
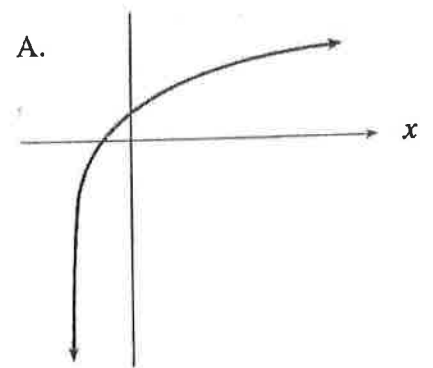
109. A recent earthquake in Turkey measured 7.2 on the Richter scale. In 1960, the earthquake in Morocco measured 5.8. How many times as intense was the Moroccan earthquake compared to the recent Turkey earthquake?

- A. 1.24
- B. 1.4
- C. 17.43
- D. 25.12

110. If the graph of $y = \log_a x$ goes through the point $(1024, 5)$, determine a .

- A. 4
- B. 4.31
- C. 10
- D. 204.8

111. Which graph best represents the function $y = \log_2(x-2)$?



112. A sample of water contains 200 g of pollutants. Each time the sample is passed through a filter, 20% of its pollutants are removed. Determine an expression that gives the number of grams of pollutants still in the water after it passes through five filters.

- A. $200(0.8)^4$
- B. $200(1.2)^4$
- C. $200(0.8)^5$
- D. $200(1.2)^5$

113/ If $\log_a x = 3$ and $\log_a y = 4$, evaluate $\left(\log_a \frac{1}{xy}\right)^2$.

- A. $\frac{1}{49}$
- B. 1
- C. 14
- D. 49

114. Simplify: $e^{\ln a}$

- A. a
- B. e^a
- C. $\ln a$
- D. ae

115. Solve algebraically: $\log_2 x + \log_2(x-7) = 3$

AUG 2002

116. Change $\log_4 c = x$ to exponential form.

- A. $x^4 = c$
- B. $4^x = c$
- C. $4^c = x$
- D. $c^x = 4$

117. Determine the domain of $y = 2 \log_4(x-1) + 5$.

- A. $x > 1$
- B. $x > 4$
- C. $x > 5$
- D. all real numbers

118. Solve: $25^{x+3} = 125^{2x-1}$

- A. $-\frac{16}{3}$
- B. 1
- C. $\frac{11}{8}$
- D. $\frac{9}{4}$

119. Solve: $\log_4(x^2 + 1) - \log_4 6 = \log_4 5$

- A. $\sqrt{10}$
- B. $\pm\sqrt{10}$
- C. $\sqrt{29}$
- D. $\pm\sqrt{29}$

120. Determine the x -intercept of $y = \log_2(x+4) + 1$.

- A. -3
- B. -3.5
- C. -3.9
- D. -4

121. Max invests \$5 000 at an interest rate of 6% per annum, compounded monthly. Which expression represents the amount of Max's investment after t years?

- A. $5\,000(1.06)^{12t}$
- B. $5\,000(1.005)^{12t}$
- C. $5\,000(1.06)^t$
- D. $5\,000(1.005)^{\frac{t}{12}}$

122. Which expression is equivalent to $\log(m^2n)^3$?

- A. $6\log m + 3\log n$
- B. $6\log m + \log n$
- C. $(2\log m + \log n)^3$
- D. $\log 3m^2 + \log 3n$

123. Simplify: $\ln e^{x^5}$

- A. 5
- B. $5x$
- C. x^5
- D. $\frac{x}{5}$

124. A radioactive substance is produced from nuclear fallout. If 250 g of this substance decays to 150 g in 30 years, what is the half-life of this substance? (Solve algebraically using logarithms.) (Answer accurate to at least 2 decimal places.)

SPECS 2002

125. Evaluate: $\log_{5.3} 210$

- A. 0.31
- B. 1.60
- C. 2.31
- D. 3.21

126. Solve: $27^{x+2} = \left(\frac{1}{3}\right)^{3-6x}$

- A. $-\frac{1}{3}$
- B. $\frac{1}{7}$
- C. $\frac{5}{3}$
- D. 3

JAN 2003

127. Determine an equation of the asymptote of $f(x) = 2^{x-1} + 3$.

- A. $y = 2$
- B. $y = -2$
- C. $y = 3$
- D. $y = -3$

128. The pH scale measures the acidity (0–7) or alkalinity (7–14) of a solution. It is a logarithmic scale in base 10. Thus, a pH of 12 is 10 times more alkaline than a pH of 11. If bleach has a pH of 13, how many times more alkaline is it than blood which has a pH of 8?

- A. 1.625
- B. 5
- C. 50
- D. 100 000

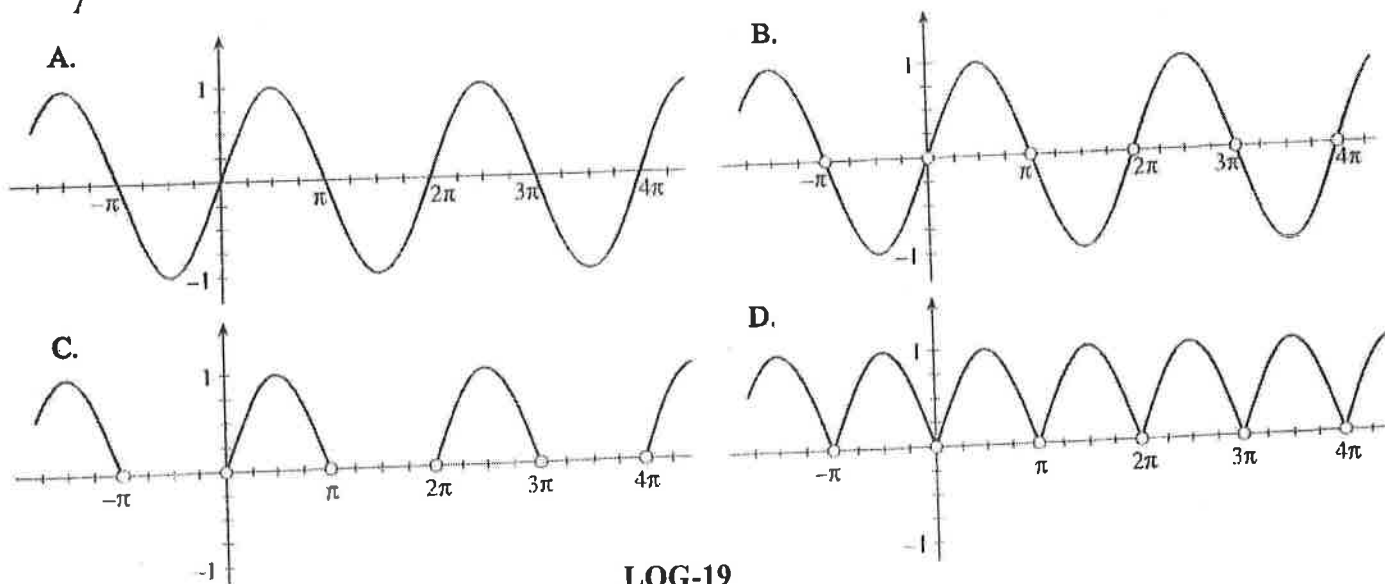
129. If $\log_3(m+n) = 2$, $(m+n) > 0$, express m in terms of n .

- A. $m = 9 - n$
- B. $m = 6 - n$
- C. $m = \frac{9}{n}$
- D. $m = \frac{6}{n}$

130. A radioactive substance decays continuously according to the formula $N = Ce^{kt}$, where N is the final amount, C is the initial amount, k is a constant, and t is the time in years. If 50 grams of the substance decays to 20 grams in 10 years, determine the value of k .

- A. -0.0916
- B. -0.0398
- C. 0.0610
- D. 0.0916

131. Which graph best represents the function $\log y = \log(\sin x)$?



132. Solve algebraically: $2 \log(3 - x) = \log 4 + \log(6 - x)$

JUN 2003

133. Determine the domain of the function $y = \log(3x - 5)$.

A. $x > -\frac{5}{3}$

B. $x > -\frac{3}{5}$

C. $x > \frac{3}{5}$

D. $x > \frac{5}{3}$

134. Express as a single logarithm:

$$\log a - 2 \log b - \log c$$

A. $\log \frac{ac}{2b}$

B. $\log \frac{ac}{b^2}$

C. $\log \frac{a}{2bc}$

D. $\log \frac{a}{b^2c}$

135. Solve for x : $8^{x-1} = \left(\frac{1}{16}\right)^{5-x}$

A. $-\frac{19}{4}$

B. -3

C. $\frac{23}{7}$

D. 17

136. An earthquake off the coast of Alaska measured 6.4 on the Richter scale. Another earthquake near Japan was 50 times as intense. What was the Richter scale reading for the earthquake near Japan?

A. 7.1

B. 7.9

C. 8.1

D. 10.9

137. Which expression gives the amount that an investment of P dollars will grow to after 4 years if it is compounded semi-annually at a rate of 5% per annum?
- A. $P(1.05)^4$
 - B. $P(1.025)^4$
 - C. $P(1.05)^8$
 - D. $P(1.025)^8$
138. Given that $y_1 = \log_a 0.4$ and $y_2 = \log_a 4$, where $0 < a < 1$, which of the following **must** be true?
- A. $y_1 < y_2$
 - B. $y_1 > y_2$
 - C. $0.4 < y_1 < 4$
 - D. $0.4 < y_2 < 4$
139. If 200 g of a substance decays to 17 g in 28 days, determine the half-life of this substance. (Solve algebraically using logarithms. Answer accurate to at least 2 decimal places.)

JAN 2004

140. Evaluate: $\log_3 59.2$
- A. 0.27
 - B. 1.30
 - C. 3.71
 - D. 19.73
141. Determine the domain of $y = \log_a(-x)$.
- A. $x < 0$
 - B. $x > 0$
 - C. $x \leq 0$
 - D. $x \geq 0$
142. Express as a single logarithm: $\log A - 3 \log B + \log C$
- A. $\log \frac{AC}{3B}$
 - B. $\log \frac{AC}{B^3}$
 - C. $\log \frac{A}{B^3 C}$
 - D. $\log(A - 3B + C)$

143. If the point $(2, 9)$ is on the graph of $y = a^x$, what point must be on the graph of $y = \log_a x$?
- A. $(2, \frac{1}{9})$
 - B. $(2, 9)$
 - C. $(9, -2)$
 - D. $(9, 2)$
144. Solve: $\log_2(3-2x) - \log_2(2-x) = \log_2 3$
- A. -2
 - B. $\frac{1}{2}$
 - C. 3
 - D. no solution
145. The number of insects in a colony can triple in 7 weeks. After 50 weeks, how many times greater will the number of insects be than after 20 weeks?
- A. 81
 - B. 110.87
 - C. 243
 - D. 2.06×10^{14}
146. A radioactive substance decays from 600 g to 105 g in twelve days. Determine the half-life for this substance.
- A. 4.77 d
 - B. 5.27 d
 - C. 7.43 d
 - D. 30.17 d
147. Solve algebraically using logarithms: $2^x = 5^{x+1}$
(Answer accurate to at least 2 decimal places.)

JUN 2004

148. Give the domain of $f(x) = \log_7(x+6) + 12$.

- A. $x > 6$
- B. $x > -6$
- C. $x > 12$
- D. $x > -12$

149. Express $\log_5 30$ using logarithms in base 4.

- A. $\log_4 30 - \log_4 5$
- B. $\frac{\log_4 5}{\log_4 30}$
- C. $\frac{\log_4 30}{\log_4 5}$
- D. $\frac{\log_{30} 4}{\log_5 4}$

150. Solve: $\left(\frac{1}{9}\right)^x = 27^{2-x}$

- A. -6
- B. $\frac{6}{5}$
- C. 2
- D. 6

151. Which expression is equivalent to $\log \frac{x}{2y^3}$?

- A. $\log x - \log 2 + 3 \log y$
- B. $\log x - 3 \log 2 + 3 \log y$
- C. $\log x - \log 2 - 3 \log y$
- D. $\log x - 3 \log 2 - 3 \log y$

152. Solve: $\log_2 x + \log_2(x-1) = 3$

- A. 2.37
- B. 3
- C. 3.37
- D. 3.5

153. The formula $A = P(1.09)^t$ is an example of exponential growth with base 1.09. Determine an equivalent continuous growth formula using base e , $A = Pe^{kt}$.

- A. $A = Pe^{0.086t}$
- B. $A = Pe^{1.086t}$
- C. $A = Pe^{0.86t}$
- D. $A = Pe^{1.86t}$

154. Determine an exponential function in the form $y = 3^{x-h} + k$ with y-intercept 5 and asymptote $y = -4$.

- A. $y = 3^{x-4} + 5$
- B. $y = 3^{x-2} - 4$
- C. $y = 3^{x-5} - 4$
- D. $y = 3^{x+2} - 4$

AUG 2005

155. Express as a single logarithm:



$$\log m - \log n - 3 \log k$$

- A. $\log \frac{m}{nk^3}$
- B. $\log \frac{m}{3nk}$
- C. $\log \frac{mk^3}{n}$
- D. $\log \frac{3mk}{n}$

156. Determine the domain of the function $y = \log(x-5)$.



- A. $x \geq 5$
- B. $x > 5$
- C. $x \leq 5$
- D. $x < 5$

157. Simplify: $9 \log_{27} x - 4 \log_9 x$



- A. $\log_3 x$
- B. $\log_9 x$
- C. $\log_{27} x$
- D. $\frac{3}{4} \log_3 x$

158. A particular type of bacteria multiplies 5-fold every 30 minutes. Initially there are 100 bacteria. Determine an expression for the number of bacteria after k minutes.

- A. $\frac{100(5)^k}{30}$
- B. $100(5)^{30k}$
- C. $100(5)^{\frac{30}{k}}$
- D. $100(5)^{\frac{k}{30}}$

159. Given $f(x) = 2^x + 5$, determine $f^{-1}(x)$, the inverse of $f(x)$.

- A. $f^{-1}(x) = 5 + \log_2 x$
- B. $f^{-1}(x) = -5 + \log_2 x$
- C. $f^{-1}(x) = \log_2(x + 5)$
- D. $f^{-1}(x) = \log_2(x - 5)$

160. Solve algebraically: $2 \log_3(x+4) - \log_3(-x) = 2$

AUG 2006

161. Change $\log_a p = t$ to exponential form.



A. $p^t = a$

B. $a^t = p$

C. $a^p = t$

D. $t^p = a$

162. Solve: $\log_5(3x) - \log_5(x-3) = 2$



A. -6

B. $-\frac{1}{2}$

C. $\frac{75}{22}$

D. 11

163. A population grows continuously according to the formula $P = P_0 e^{kt}$, where P is the final population in t years, P_0 is the initial population and k is the continuous growth rate. What will be the population in 7 years if the initial population is 25 000 and the continuous growth rate is 1.2%?

A. 27 191

B. 57 909

C. 177 113

D. 197 312

164. A radioactive substance has a half-life of 17 d. How long will it take for 300 g of this substance to decay to 95 g?

(Solve algebraically using logarithms. Answer accurate to at least 2 decimal places.)

SAMPLE 2008

165. Determine the domain of $y = \log(x+1)$.

A. $x < 1$

B. $x > 1$

C. $x < -1$

D. $x > -1$

166. Determine an equivalent expression for $\log \frac{100a^2}{\sqrt{b}}$.

A. $2 \log 100a - \frac{1}{2} \log b$

B. $2 + 2 \log a - \frac{1}{2} \log b$

C. $4 \log a - \frac{1}{2} \log b$

D. $100 + 2 \log a - \frac{1}{2} \log b$

167. Evaluate: $\log_{\sqrt{7}} 7^3$

- A. $\frac{2}{3}$
- B. $\frac{3}{2}$
- C. 6
- D. 9

168. As an iceberg melts during the summer, it loses 3% of its mass every 5 days. This iceberg reduces to 40% of its original mass after t days. Which equation could be used to determine the value of t ?

- A. $40 = 100(0.97)^{\frac{t}{5}}$
- B. $40 = 100(0.97)^{\frac{5}{t}}$
- C. $40 = 100(1.03)^{\frac{t}{5}}$
- D. $40 = 100(1.03)^{\frac{5}{t}}$

169. Solve: $\log_2(\log_9 x) = -1$

- A. $\frac{1}{81}$
- B. $\frac{1}{3}$
- C. 3
- D. 81

170. Solve: $5^{x+1} = 2(3^{2x})$

- A. $x = \frac{-\log 5}{1 - 2 \log 6}$
- B. $x = \frac{-\log 5}{\log 5 - 2 \log 6}$
- C. $x = \frac{\log 2 - \log 5}{1 - 2 \log 3}$
- D. $x = \frac{\log 2 - \log 5}{\log 5 - 2 \log 3}$

171. Change to logarithmic form $a^3 = b$.

- A. $3 = \log_a b$
- B. $3 = \log_b a$
- C. $b = \log_a 3$
- D. $a = \log_b 3$

172. A population grows continuously according to the formula $P = P_0 e^{kt}$, where P is the final population at the end of t years, P_0 is the initial population and k is the annual growth rate. What will the population be at the end of 8 years if the initial population is 15 million and the annual growth rate is 4%?

- A. 20.66 million
- B. 124.90 million
- C. 179.02 million
- D. 367.99 million

173. Determine the magnitude of an earthquake that is half as intense as an earthquake of magnitude 8.0 on the Richter scale.

- A. 4.0
- B. 5.0
- C. 7.7
- D. 8.3

174. Solve algebraically $\log 2 - \log(x-1) = \log(x+1) - \log(x+17)$.

JAN 2008

175. Determine an equation for the asymptote of the graph of $y = 2^{x+3} + 4$.



- A. $y = 4$
- B. $x = 3$
- C. $x = -3$
- D. $y = -4$

176. Solve: $9^x = 27^{x-3}$



- A. -9
- B. 3
- C. $\frac{9}{2}$
- D. 9

177. Solve: $\log_5(3x) - \log_5(x-3) = 2$



- A. -6
- B. $-\frac{1}{2}$
- C. $\frac{75}{22}$
- D. 11

178. Evaluate: $\log_5 \sqrt{5^3}$



- A. $\frac{1}{6}$
- B. $\frac{2}{3}$
- C. $\frac{3}{2}$
- D. 6

179. If $\log_2 5 = x$ and $\log_2 3 = y$, determine an expression for $\log_2 \left(\frac{15}{2} \right)$, in terms of x and y .



- A. xy
- B. $x + y$
- C. $xy - 1$
- D. $x + y - 1$

180. Solve: $\log_2 (\log_x (x + 6)) = 1$



- A. 2
- B. 3
- C. 2, 3
- D. -2, 3

181. Change $\log_2 (3x) = 5$ to exponential form.

- A. $3x = 2^5$
- B. $3x = 5^2$
- C. $2 = (3x)^5$
- D. $2 = 3x^5$

182. In 1872, Washington State experienced an earthquake of magnitude 6.8 on the Richter scale. Determine the magnitude on the Richter scale of an earthquake that is half as intense as the Washington State earthquake.

- A. 3.4
- B. 6.0
- C. 6.5
- D. 7.1

183. A population grows continuously according to the formula $P = P_0 e^{kt}$, where P is the final population at the end of t years, P_0 is the initial population, and k is the annual growth rate. What will the population be at the end of 10 years if the initial population is 5000 and the annual growth rate is 3%?

- A. 6 720
- B. 6 749
- C. 51 523
- D. 100 428

184. In a population of moths, 78 moths increase to 1000 moths in 40 weeks. What is the doubling time for this population of moths?

(Solve algebraically using logarithms. Answer accurate to at least 2 decimal places.)

(5 marks)

ADDITIONAL QUESTIONS

185. Simplify: $(\log_x y)(\log_y x)$

- A. 0
- B. 1
- C. $xy^{(x+y)}$
- D. $\log_{xy}(x+y)$

186. Simplify: $\log_b(b\sqrt{b})$

- A. $\frac{1}{2}$
- B. $\frac{3}{2}$
- C. $b^{\frac{1}{2}}$
- D. $b^{\frac{3}{2}}$

187. If $\log_5 x = 4.26$, what is the value of $\log_5 25x^2$?

- A. 2.66
- B. 3.80
- C. 8.26
- D. 10.52

188. Which of the following is equivalent to $\log 3x^2$?

- A. $2(\log 3 + \log x)$
- B. $\log 9 - 2 \log x$
- C. $2 \log 3 + \log x$
- D. $\log 3 + 2 \log x$

189. If $a = b^{c \log_b d}$, then which of the following **must** be true?

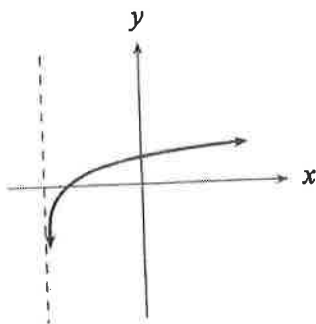
- A. $a = cd$
- B. $a = b^c$
- C. $a = d^c$
- D. $a = dc$

190. If $a = 2 \log_4 Q$ and $b = \log_4 P$, determine an expression for $\frac{Q}{P}$.

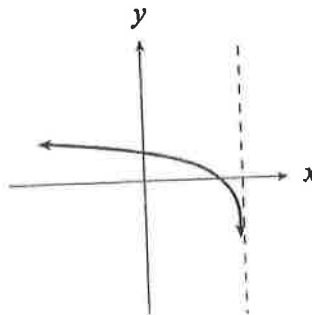
- A. $\frac{a}{2b}$
- B. $\frac{2a}{b}$
- C. 2^{a-2b}
- D. 2^{2a-b}

191/ Which graph best represents the function $y = -\log_3(x+5)$?

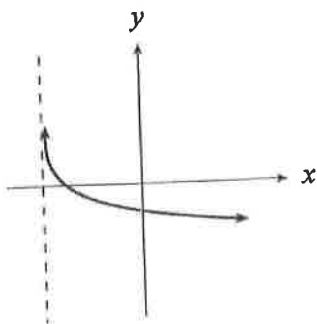
A.



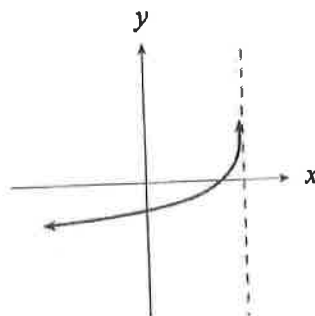
B.



C.



D.



192. Given that $y_1 = \log_a 5$ and $y_2 = \log_a 3$ where $0 < a < 1$, which of the following must be true?

- A. $y_1 > 5$
- B. $y_1 < y_2$
- C. $y_1 > y_2$
- D. $3 < y_2 < 5$

193. The inverse relation of $y = \log 2x$ is given by which one of the following?

- A. $y = \frac{10^x}{2}$
- B. $y = 5^x$
- C. $y = 10^{2x}$
- D. $y = \frac{1}{\log 2x}$

194. Solve for x : $\log_2[\log_x(\log_3 9)] = -1$

- A. 2
- B. 3
- C. 4
- D. 5

~~195.~~ Evaluate: $\sum_{k=3}^5 \log_k k^2$

A. 1

B. 2

C. 6

D. 8

~~196.~~ Evaluate: $\sum_{k=2}^4 \log_6 k$

A. 0.60

B. 1.23

C. 1.77

D. 4.00

~~197.~~ Determine the sum of the first 12 terms of the series $\log_b 1 + \log_b 10 + \log_b 100 + \dots$

A. $\frac{66}{\log b}$

B. $\frac{72}{\log b}$

C. 66

D. 72

Solve for x :

198. $2\log(3-x) = \log 2 + \log(22-2x)$

199. $\log_{12}(3-x) + \log_{12}(2-x) = 1$

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

201. $\log(10-3x) - 2\log x = 0$

202. $\log_4(7-3x) + \log_4(x+4) = 2$

203. $\log_2(x+7) + \log_2(x+5) = 3$

2009 SAMPLE QUESTIONS

204. Solve for x : $81^{x-1} = \left(\frac{1}{27}\right)^{x-4}$

- A. -8 B. -3 C. $-\frac{3}{7}$ D. $\frac{16}{7}$

205. Solve for x : $9^{x+2} = (3^{4x-3})(3^5)$

- A. 0 B. 1 C. $\frac{17}{19}$ D. $\frac{19}{18}$

206. Solve for x : $5 = 3^x$

- A. $x = \log_5 3$ B. $x = \log_3 5$ C. $x = 3^5$ D. $x = 5^3$

207. Solve for x : $ab^x = c$

- A. $x = \frac{\log c}{\log a + \log b}$ B. $x = \frac{\log c + \log a}{\log b}$
 C. $x = \frac{\log c - \log a}{\log b}$ D. $x = \frac{\log c}{\log b} - \log a$

208. Solve algebraically using logarithms: $2^x = 3(5^{x+1})$
 (Answer accurate to at least 2 decimal places.)

209. Solve for x : $\log(3-x) + \log(3+x) = \log 5$

- A. $x = -2$ B. $x = 2$ C. $x = \pm 2$ D. no solution

210. Solve: $\log_2 8 + \log_3 \frac{1}{3} = \log_4 x$

- A. $\frac{1}{64}$ B. $\frac{1}{16}$ C. 16 D. 64

211. Solve the following: $\log_2(\log_4(\log_5 x)) = -1$

- A. $\frac{1}{25}$ B. 5 C. 25 D. 125

212. Solve algebraically: $2\log_4 x - \log_4(x+3) = 1$

213. Simplify: $\log_2 4^x$

- A. x B. $2x$ C. 2^x D. x^2

214. Write as a single logarithm: $3 + \frac{1}{2}\log_2 x - 3\log_2 y$

- A. $\log_2\left(\frac{1000\sqrt{x}}{y^3}\right)$ B. $\log_2\left(\frac{8\sqrt{x}}{y^3}\right)$
C. $\log_2(1000 + \sqrt{x} - y^3)$ D. $\log_2(8 + \sqrt{x} - y^3)$

215. If $\log_4 x = a$, determine $\log_{16} x$ in terms of a .

- A. $\frac{a}{4}$ B. $\frac{a}{2}$ C. $2a$ D. $4a$

216. If $\log 2 = a$, $\log 3 = b$, determine an expression for $\log 2400$.

- A. $2a^3b$ B. $3a + b + 2$ C. $3a + b + 100$ D. $a^3 + b + 2$

217. Simplify: $a^{\log_a 8 + \log_a 2}$

- A. 10 B. 16 C. a^{10} D. a^{16}

218. Determine the value of $\log_n ab^2$ if $\log_n a = 5$ and $\log_n b = 3$.

- A. 11 B. 14 C. 16 D. 45

219. Given $\log_a 2 = x$ and $(\log_a 8)(a^{\log_a x}) = 12$, solve for a .

- A. 2 B. ± 2 C. $\sqrt{2}$ D. $\pm\sqrt{2}$

220. Change to exponential form: $\log_k \ell = m$

- A. $\ell = m^k$ B. $\ell = k^m$ C. $k = m^\ell$ D. $k = \ell^m$

221. If (a, b) is on the graph of $y = 3^x$, which point must be on the graph of $y = \log_3 x$?

- A. (a, b) B. (b, a) C. $(3a, b)$ D. $(a, 3b)$

222. Determine the inverse of $f(x) = 3^{x-1} - 2$.

- A. $f^{-1}(x) = \log_3(x+2)+1$ B. $f^{-1}(x) = \log_3(x+2)-1$
C. $f^{-1}(x) = \log_3(x-1)+2$ D. $f^{-1}(x) = \log_3(x-1)-2$

223. If \$5000 is invested at 7.2% per annum compounded monthly, which equation can be used to determine the number of years, t , for the investment to increase to \$8000?

- A. $8000 = 5000(1.072)^t$ B. $8000 = 5000(1.006)^t$
C. $8000 = 5000(1.072)^{12t}$ D. $8000 = 5000(1.006)^{12t}$

~~224.~~ The population of a particular country is 25 million. Assuming the population is growing continuously, the population, P , in millions, t years from now can be determined by the formula $P = 25e^{0.022t}$. What will be the population, in millions, 20 years from now?

- A. 29.90 B. 37.97 C. 38.63 D. 38.82

225. The population of a nest of ants can multiply threefold (triple) in 8 weeks. If the population is now 12 000, how many weeks will it take for the population to reach 300 000 ants? (Solve algebraically using logarithms. Answer accurate to at least 2 decimal places.)

226. The radioactivity of a certain substance decays by 20% in 30 hours. What is the half-life of the substance?

227. The intensity of light reduces by 7% for every 3 metres below the surface of the water. At what depth will the light intensity be reduced to 60% of its original amount?

228. The population of Canada is 30 million people and is growing at an annual rate of 1.4%. The population of Germany is 80 million people and is decreasing at an annual rate of 1.7%. In how many years will the population of Canada be equal to the population of Germany? (Solve algebraically using logarithms. Answer accurate to at least 2 decimal places.)

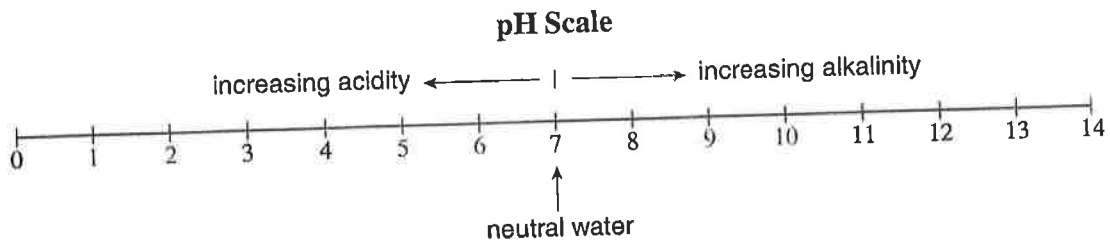
229. Determine the domain of the function $y = \log(2x + 3)$.

- A. $x > -\frac{3}{2}$ B. $x > -\frac{2}{3}$ C. $x > \frac{2}{3}$ D. $x > \frac{3}{2}$

230. In 1976, an earthquake in Guatemala had a magnitude of 7.5 on the Richter scale and in 1960, an earthquake in Morocco had a magnitude of 5.8. How many times as intense was the 1976 Guatemalan earthquake compared to the 1960 Moroccan earthquake?

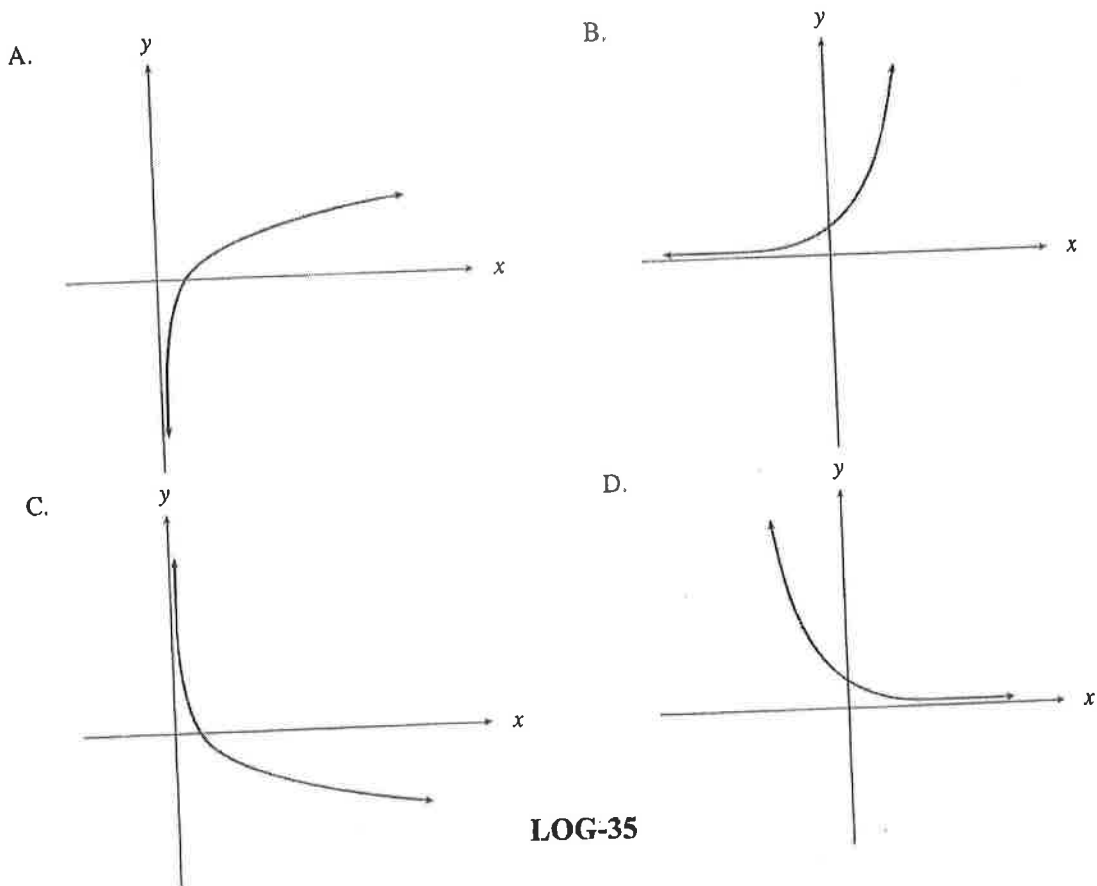
- A. 1.29 B. 1.7 C. $10^{1.29}$ D. $10^{1.7}$

231. In chemistry, the pH scale measures the acidity (0–7) or alkalinity (7–14) of a solution. It is a logarithmic scale in base 10. Thus, a pH of 5 is 10 times more acidic than a pH of 6. Solution A has a pH of 5.7. Solution B is 1260 times more acidic than Solution A. Find the pH of Solution B.

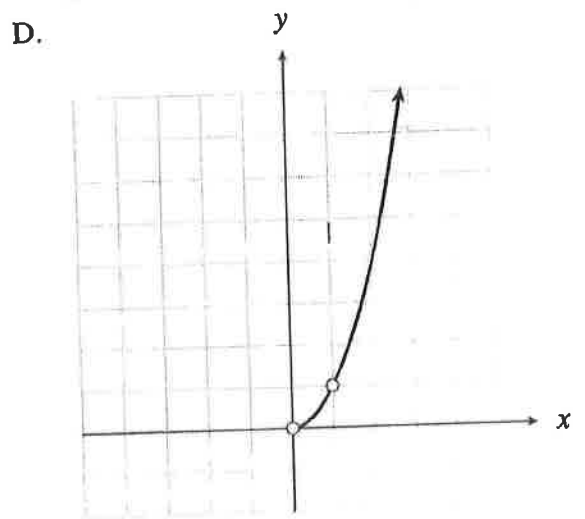
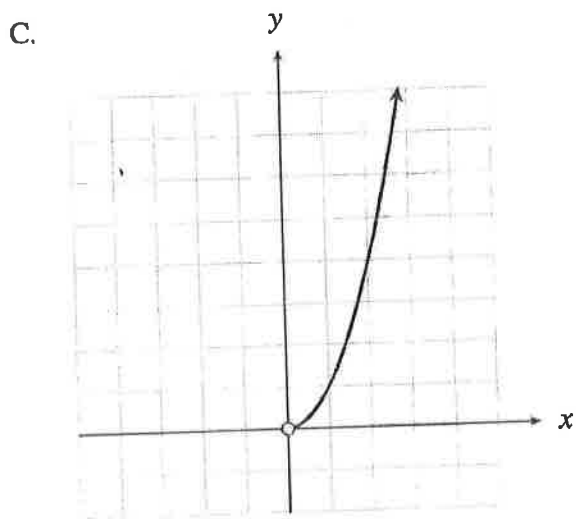
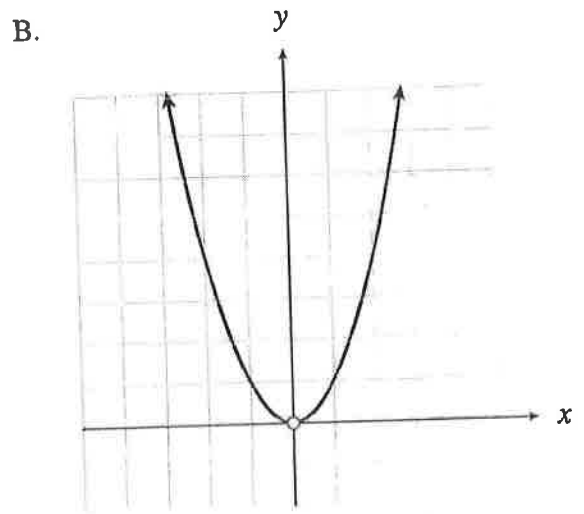
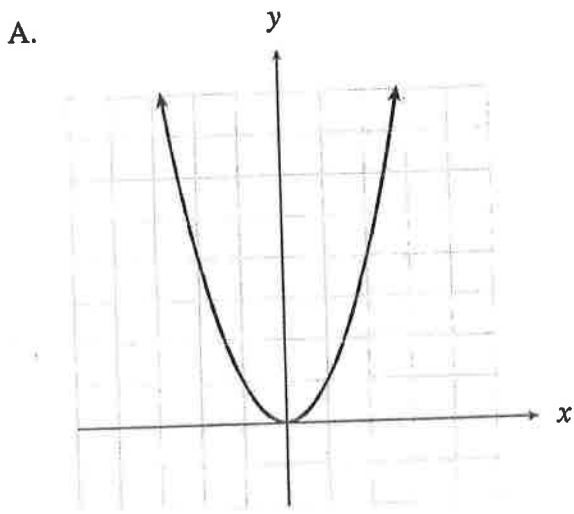


- A. 2.6 B. 4.4 C. 7.0 D. 8.8

232. If $0 < a < 1$, which of the following is the best graph of $y = \log_a x$?



233. Which of the following is a graph of $\log_x y = 2$?



LOGARITHMS

1	D	56	137 years	107	D	162	C	217	B
2	D	57	$y = 8x$	108	A	163	A	218	A
3	B		$x > 0, y > 0, y \neq 1$	109	D	164	28.20 days	219	C
4	B	58	A	110	A	165	D	220	B
5	C	59	C	111	B	166	B	221	B
6	D	60	A	112	C	167	C	222	A
7	C	61	C	113	D	168	A	223	D
8	15.6 years	62	A	114	A	169	C	224	D
9	A	63	B	115	$x = 8$	170	D	225	23.44 weeks
10	C	64	D	116	B	171	A	226	93.19 h
11	A	65	$y = \frac{x^2}{27}$	117	A	172	A	227	21.12 m
12	B		$x > 0, y > 0, y \neq 1$	118	D	173	C	228	31.59 years
13	B	66	B	119	D	174	$x = 7$	229	A
14	D	67	D	120	B	175	A	230	D
15	D	68	A	121	B	176	D	231	A
16	B	69	C	122	A	177	C	232	C
17	$x = -2$	70	A	123	C	178	C	233	D
18	A	71	D	124	40.71 years	179	D		
19	A	72	D	125	D	180	B		
20	D	73	C	126	D	181	A		
21	C	74	D	127	C	182	C		
22	B	75	A	128	D	183	B		
23	A	76	C	129	A	184	$n = 10.87$		
24	A	77	A	130	A	185	B		
25	4 165 600	78	D	131	C	186	B		
26	B	79	A	132	$x = -3$	187	D		
27	A	80	A	133	D	188	D		
28	A	81	C	134	D	189	C		
29	D	82	$y = -2$	135	D	190	C		
30	A		$(0, 3), (\log_5 2 - 1, 0)$	136	C	191	C		
31	B	83	36 848 years	137	D	192	B		
32	A	84	D	138	B	193	A		
33	$x = \frac{5}{2}$	85	B	139	7.87 days	194	C		
34	C	86	A	140	C	195	C		
35	A	87	26 weeks	141	A	196	C		
36	B	88	B	142	B	197	A		
37	A	89	D	143	D	198	$x = -5$		
38	A	90	A	144	D	199	$x = -1$		
39	C	91	B	145	B	200	$x = \frac{1}{2}$		
40	B	92	C	146	A	201	$x = 2$		
41	92.88 weeks	93	D	147	$x = -1.76$	202	$x = \frac{4}{3}$ or -3		
42	B	94	B	148	B	203	$x = -3$		
43	A	95	B	149	C	204	D		
44	C	96	130.03 days	150	D	205	B		
45	A	97	D	151	C	206	B		
46	B	98	C	152	C	207	C		
47	B	99	A	153	A	208	$x = -2.96$		
48	D	100	D	154	D	209	C		
49	D	101	D	155	A	210	C		
50	A	102	C	156	B	211	C		
51	D	103	D	157	A	212	$x = 6$		
52	D	104	C	158	D	213	B		
53	D	105	$x = -3$	159	D	214	B		
54	B	106	$k = 0.14$	160	$x = -1$	215	B		
55	C			161	B	216	B		