

Warm up

1. Sketch by hand. $f(x) = 2e^{-x} + 3$

2. Expand

a. $\log_5 \left(\frac{(3x+1)^2}{y^4 z^3} \right)$
 $2\log_5(3x+1) - 4\log_5 y - 3\log_5 z$

b. $\ln(3\sqrt{x}y^3z^7)$
 $\ln 3 + \frac{1}{2}\ln x + 3\ln y + 7\ln z$

3. Condense.
 $\log_2 \left(\frac{\log_2 9 - 4}{x^4(x+1)} \right) \log_2 x - \log_2(x+1)$

4. Evaluate

a. $\log_2 6 - \log_2 3 = \log_2 \frac{6}{3}$

b. $\log_3 9 + \log_4 16 - \log_{10} 10$
 $\log_3 3^2 + \log_4 4^2 - 1$
 $2 + 2 - 1 = 3$

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p 211 Homework Questions

In Exercises 1-8, rewrite the logarithm as a ratio of (a) common logarithms and (b) natural logarithms.

1. $\log_5 x$
2. $\log_3 x$
3. $\log_{12} x$
4. $\log_{12} x$
5. $\log_6 \frac{1}{3}$
6. $\log_6 \frac{1}{2}$
7. $\log_{2.4} x$
8. $\log_{2.1} x$

In Exercises 9-16, evaluate the logarithm using the change-of-base formula. Round your result to three decimal places.

9. $\log_2 7$
10. $\log_2 4$
11. $\log_{12} 4$
12. $\log_{12} 64$
13. $\log_6(0.8)$
14. $\log_6(0.015)$
15. $\log_{10} 1460$
16. $\log_{10} 135$

In Exercises 17-56, use the properties of logarithms to expand the expression as a sum, difference, and/or constant multiple of logarithms. (Assume all variables are positive.)

37. $\log_{10} 5x$
38. $\log_{10} 10z$
39. $\log_{10} \frac{5}{x}$
40. $\log_{10} \frac{x}{2}$
41. $\log_6 x^4$
42. $\log_6 z^{-3}$
43. $\ln \sqrt{z}$
44. $\ln \sqrt[3]{z}$
45. $\ln xyz$
46. $\ln \frac{xy}{z}$
47. $\log_6 w^2 h^3$
48. $\log_6 x^2 y^2 z$
49. $\ln(a^2 \sqrt{a-1})$, $a > 1$
50. $\ln(z(z-1)^2)$, $z > 1$
51. $\ln \sqrt{\frac{x}{y}}$
52. $\ln \sqrt{\frac{x^2}{y^2}}$
53. $\ln \left(\frac{x^2-1}{x^2} \right)$, $x > 1$
54. $\ln \sqrt{\frac{x}{x+1}}$
55. $\ln \frac{x^2 \sqrt{y}}{z^3}$
56. $\log_6 \frac{\sqrt{2} x^4}{z^4}$

In Exercises 59-76, condense the expression to the logarithm of a single quantity.


59. $\ln x + \ln 4$
60. $\ln y + \ln z$
61. $\log_4 z - \log_4 y$
62. $\log_8 8 - \log_8 t$
63. $2\log_2(x+3)$
64. $\frac{1}{2}\log_6(z-4)$
65. $\frac{1}{3}\ln(x^2+9)$
66. $2\ln x + \ln(x+1)$
67. $\ln x - \ln(x+1)$
68. $\ln x - 2\ln(x+2)$
69. $\ln(x-2) - \ln(x+2)$
70. $3\ln x + 2\ln y - 4\ln z$
71. $\ln x - 2[\ln(x+2) + \ln(x-2)]$
72. $4[\ln(x+5) + \ln(x-2)] - 2\ln(z-5)$
73. $\frac{1}{2}[\ln(x+3) + \ln(x-2)] - \ln(x-1)$
74. $2[\ln(x - \ln(x+1)) - \ln(x-1)]$
75. $\frac{1}{2}[\ln(y+2\ln y+4)] - \ln(y-1)$
76. $\frac{1}{2}[\ln(x+1) + 2\ln(x-1)] + 3\ln x$

In Exercises 81-94, find the exact value of the logarithm without using a calculator. If this is not possible, state the reason.

81. $\log_9 9$
82. $\log_2 \sqrt{5}$
83. $\log_4 10^2$
84. $\log_6 \left(\frac{1}{18} \right)$
85. $\log_2(-4)$
86. $\log_2(-16)$
87. $\log_7 75 - \log_7 3$
88. $\log_2 2 + \log_2 32$
89. $\ln e^3 - \ln e^2$
90. $\ln e^4 - 2\ln e^3$
91. $2\ln e^4$
92. $\ln e^{1/3}$

Handwritten notes on the page:
 $\ln \frac{x}{(x+1)^2}$
 $\ln \sqrt{\frac{x(x+3)^2}{x^2-1}}$
 $\log_9 16^{3/4}$
 $\log_3 4(9)^{3/4}$
 $\log_4 4^{6/8}$
 $6/8$

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p 221 **Homework Questions**

In Exercises 1-8, determine whether each x-value is a solution of the equation.

1. $4^{2x-7} = 64$	2. $2^{3x+1} = 32$
(a) $x = 5$	(a) $x = -1$
(b) $x = 2$	(b) $x = 2$

3. $3e^{x+2} = 75$

(a) $x = -2 + \ln 25$

(b) $x = -2 + \ln 25$

(c) $x = -1.2189$

4. $4e^{x-1} = 60$

(a) $x = 1 + \ln 15$

(b) $x = 3.7081$

(c) $x = \ln 16$

$3e^{x+2} = 75$
 $3e^{x+2} = 75 \cdot \ln$
 $3e^{x+2+\ln 75} = 75$
 $3e^{\ln 15} = 75$
 $3 \cdot 25 = 75 \checkmark$

In Exercises 9-16, use a graphing utility to graph f and g in the same viewing window. Approximate the point of intersection of the graphs of f and g . Then solve the equation $f(x) = g(x)$ algebraically.

9. $f(x) = 2^x$	10. $f(x) = 27^x$
$g(x) = 8$	$g(x) = 9$

11. $f(x) = 5^x - 2 - 15$

$g(x) = 10$

12. $f(x) = 2^{x+1} - 3$

$g(x) = 13$

$3e^{x+2+\ln 75} = 75$
 $3e^{\ln 15} = 75$
 $3 \cdot 25 = 75 \checkmark$

In Exercises 17-28, solve the exponential equation.

17. $4^x = 16$	18. $3^x = 243$
19. $5^x = \frac{25}{5}$	20. $7^x = \frac{1}{49}$
21. $(\frac{2}{3})^x = 64$	22. $(\frac{2}{3})^x = 32$
23. $(\frac{2}{3})^x = \frac{16}{27}$	24. $(\frac{2}{3})^x = \frac{27}{16}$
25. $6(10)^x = 216$	26. $5(8)^x = 325$
27. $2^{x+3} = 256$	28. $3^{x-1} = \frac{1}{27}$

$(\frac{2}{3})^x = \frac{3}{2^4}$
 $(\frac{2}{3})^x = (\frac{2}{3})^4$

In Exercises 45-72, solve the exponential equation algebraically. Round your result to three decimal places. Use a graphing utility to verify your answer.

45. $8^{3x} = 360$	46. $6^{5x} = 3000$
47. $5^{-x/2} = 0.20$	48. $4^{-3x} = 0.10$
49. $5(2^{3-x}) - 13 = 100$	
50. $6(8^{-x-2}) + 15 = 2601$	
51. $(1 + \frac{0.10}{12})^{12x} = 2$	
57. $500e^{-x} = 300$	58. $1000e^{-4x} = 75$
59. $7 - 2e^x = 5$	60. $-14 + 3e^x = 11$
61. $e^{2x} - 4e^x - 5 = 0$	62. $e^{2x} - 5e^x + 6 = 0$
63. $250e^{0.05x} = 10,000$	64. $100e^{0.05x} = 125,000$
65. $e^x = e^{x^2-2}$	66. $e^{2x} = e^{x^2-4}$
67. $e^{x^2-3x} = e^{x-2}$	68. $e^{-x^2} = e^{x^2-2x}$

$\log_{(1+\frac{1}{12})} 2 = 12t$
 $\frac{\log 2}{\log(1+\frac{1}{12})} = 12t$

$x^2 - 3x = x - 2$
 $x^2 - 4x + 2 = 0$
 $x^2 - 4x + 2^2 = -2 + 4$
 $(x-2)^2 = 2$
 $x = 2 \pm \sqrt{2}$

In Exercises 113-120, factor the polynomial.

113. $x^2 + 2x - 3$	114. $2x^2 + 3x - 5$
115. $12x^2 + 5x - 3$	116. $16x^2 + 16x + 7$
117. $16x^2 - 25$	118. $36x^2 - 49$
119. $2x^3 + x^2 - 45x$	120. $3x^3 - 5x^2 - 12x$

In Exercises 121-124, evaluate the function for $f(x) = 3x + 2$ and $g(x) = x^2 - 1$.

121. $(f + g)(2)$	122. $(f - g)(-1)$
123. $(fg)(6)$	124. $(\frac{f}{g})(0)$

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3.4 Day 2 - Solving Logarithmic Equations

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Solve

$$\ln x = 2$$

$$e^2 = x$$

$$x = 7.39$$

$$\log x = 4$$

$$10^4 = x$$

$$10000 = x$$

$$\ln 5x = 3$$

$$\frac{e^3}{5} = \frac{5x}{5}$$

$$x = 4.02$$

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$$\log_3(3x - 2) = 2$$

$$3^2 = 3x - 2$$

$$9 = 3x - 2$$

$$11 = 3x$$

$$\frac{11}{3} = x$$

check $3\left(\frac{11}{3}\right) - 2$

$$11 - 2 = 9 \text{ pos. so } \checkmark$$

$$\log_2(x - 1) = \log_2(3x + 4)$$

$$x - 1 = 3x + 4$$

$$-5 = 2x$$

$$\cancel{-\frac{5}{2}} = x$$

no solution

Oct 25-12:25 PM

$$\ln(x+4) = 5$$

$$e^5 = x+4$$

$$e^5 - 4 = x$$

$$x = 144.41$$

$$3 + 2\ln 4x = 5$$

$$2\ln 4x = 2$$

$$\ln(4x)^2 = 2$$

$$e^2 = (4x)^2$$

$$e^2 = 16x^2$$

$$e = 4x$$

$$\frac{2\ln 4x = 2}{2} = \frac{2}{2}$$

$$\ln 4x = 1$$

$$e^1 = 4x$$

$$\frac{e}{4} = x$$

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$$\ln(x-2) + \ln(2x-3) = 2\ln x$$

$$\ln(x-2)(2x-3) = 2\ln x$$

$$\cancel{\ln(x-2)(2x-3)} = \cancel{\ln x^2}$$

$$2x^2 - 7x + 6 = x^2$$

$$x^2 - 7x + 6 = 0$$

$$(x-7)(x-1) = 0$$

$$\frac{x-7}{x-1}$$

$$\log x + \log(x+15) = 2$$

$$\log(x(x+15)) = 2$$

$$10^2 = x^2 + 15x$$

$$0 = x^2 + 15x - 100$$

$$\frac{(x+20)(x-5)}{x=-20 \quad | \quad x=5}$$

Nov 7-5:44 AM

$$2x = \ln(x+2)$$

$$x+2 = e^{2x}$$

$$y_1 = 2x$$

$$y_2 = \ln(x+2)$$

$$2x = \ln(x+2)$$

$$x = -1.98, 0.45$$

$$x = -1.98, 0.45$$

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Find x-intercepts, domain, VA, sketch problems

$$f(x) = \log_4(x+5) \quad x+5 > 0$$

$$0 = \log_4(x+5) \quad x > -5$$

$$D: (-5, \infty)$$

$$x+5 = 4^0$$

$$VA: x = -5$$

$$x+5 = 1$$

$$x = -4$$

$$y = -4 \log_3(3x+2) \quad 3x+2 > 0$$

$$0 = -4 \log_3(3x+2) \quad x > -\frac{2}{3}$$

$$VA: x = -\frac{2}{3}$$

$$-\frac{4}{-4} = \frac{-4}{-4} \quad D: (-\frac{2}{3}, \infty)$$

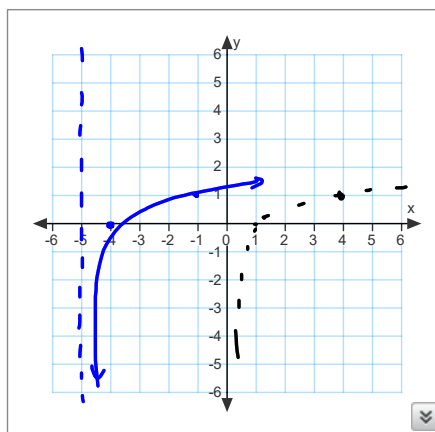
$$0 = \log_3(3x+2) \quad D: (-\frac{2}{3}, \infty)$$

$$3x+2 = 3^0$$

$$3x+2 = 1$$

$$3x = -1$$

$$x = -\frac{1}{3}$$



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HOMework



p 221 7, 15, 29-37 odd, 85-103 odd,
111-113 all, 123-127 odd,
p 203 48-52 even, 71, 73

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