Exercises ON YOUR OWN

State the property or properties used to rewrite each expression.

1. $\log 4 + \log 5 = \log 20$
2. $\log z^2 = 2 \log z$
3. $\log_3 32 - \log_3 8 = \log_3 4$
4. $\log \sqrt[3]{3x} = \frac{1}{3} \log 3x$
5. $2 \log_2 m - 4 \log_2 n = \log_2 \frac{m^2}{n^4}$
6. $\log_6 \sqrt[n]{x^p} = \frac{p}{n} \log_6 x$
7. $8 \log 2 - 2 \log 8 = \log 4$
8. $3 \log_b 4 - \log_b 8 = \log_b 8$
9. $\log_5 12 - \log_5 6 = \log_5 2$

10. *Extended* Use the properties of logarithms to rewrite log 64 in four different ways.

11. *Manufacturing* Suppose you work for a vacuum cleaner manufacturer. You helped design new components that reduce the sound intensity of a certain model from 10^{-4} W/m^2 to 6.31×10^{-6} W/m^2. By what percent do these new components reduce the vacuum cleaner's loudness? (Use $I_0 = 10^{-12}$ W/m^2.)

Write each logarithmic expression as a single logarithm.

12. $\log 7 + \log 2$
13. $\log_2 27 - \log_2 9$
14. $\frac{1}{2} \log_4 t - \log_4 s$
15. $5 \log 3 + \log 4$
16. $\log 5 + \log 8 - 2 \log 2$
17. $\log a + 3 \log b$
18. $4 \log m - \log n$
19. $\frac{1}{2}(\log_7 x + \log_7 y) - 3 \log_7 z$
20. $\log x + \log y + \log z$
21. $7 \log r - \log s + \log t$
22. $\log \frac{a}{4} + \log \frac{b}{3} - \log \frac{z}{2}$
23. $\frac{1}{4} \log_6 5 + \frac{1}{4} \log_6 x$

Expand each logarithm.

24. $\log_5 \frac{r}{s}$
25. $\log x^3 y^5$
26. $\log_3 7(2x - 3)^2$
27. $\log \frac{a^2 b^3}{c^4}$
28. $\log 3m^4 n^{-2}$
29. $\log_4 5\sqrt{x}$
30. $\log_7 22xyz$
31. $\log (2(x + 1))^3$
32. $\log_2 \left(\frac{5a}{b^2}\right)$
33. $\log_4 (4mn)^5$
34. $\log_3 (2x)^2$
35. $\log \sqrt{\frac{2x}{y}}$

36. *Writing* Explain why $\log (5 \cdot 2) \neq \log 5 \cdot \log 2$.

37. *Construction Worker* Suppose you are a worker on a road construction job. Your team is blasting rock to make way for a roadbed. One explosion has an intensity of 1.65×10^{-2} W/m^2. What is the loudness of the sound in decibels? (Use $I_0 = 10^{-12}$ W/m^2.)

Use the properties of logarithms to evaluate each expression.

38. $\log_2 4 - \log_2 16$
39. $\log_5 5 - \log_5 125$
40. $3 \log_2 2 - \log_2 4$
41. $\log 1 + \log 100$
42. $5 \log_3 3 - \log_3 9$
43. $\log_6 4 + \log_6 9$
44. $2 \log_8 4 - \frac{1}{3} \log_8 8$
45. $\log_3 81 - \log_3 27$
46. $\log_3 3 - 5 \log_3 3$

Assume that $\log 4 \approx 0.6021$, $\log 5 \approx 0.6990$, and $\log 6 \approx 0.7782$. Use the properties of logarithms to evaluate each expression. Do not use your calculator. Round your answers to the nearest thousandth.

47. $\log 20$
48. $\log 24$
49. $\log 16$
50. $\log 0.8$
51. $\log 1.25$
52. $\log 30$
53. $\log 125$
54. $\log 1.5$
55. $\log \frac{1}{36}$
56. $\log \frac{1}{4}$
57. $\log 36$
58. $\log \frac{1}{25}$

59. **Writing** Use what you know about exponents to explain why the product property is true for logarithms.

Write *true* or *false* for each statement. Justify your answer.

60. $\log_2 4 + \log_2 8 = 5$
61. $\log_5 16 - \log_3 2 = \log_5 8$
62. $\log_3 8 = 3 \log_3 2$
63. $\log_3 \frac{x}{y} = \frac{\log_3 x}{\log_3 y}$
64. $\frac{\log_b x}{\log_b y} = \log_b x - \log_b y$
65. $\log (x + 2) = \frac{\log x}{\log 2}$
66. $\log x - 4 \log y = \log \frac{x}{y^4}$
67. $\log_3 \frac{3}{2} = \frac{1}{2} \log_3 3$
68. $\frac{1}{2} \log_4 t - \log_4 s = \log_4 \frac{\sqrt{t}}{s}$

69. **Standardized Test Prep** Which expression has the greatest value when $m = 4$ and $n = 3$?

A. $3 \log m - 2 \log n$
B. $\log 3m - \log 2n$
C. $2 \log n - 3 \log m$
D. $\log 2m - \log 3n$
E. $\log n^3 - \log m^2$

Exercises MIXED REVIEW

Find the inverse of each function.

70. $y = 3x^2 - 1$
71. $y = 5x + 7$
72. $y = 2x^3 + 10$
73. $y = -x^2 + 5$

74. **Coordinate Geometry** A rectangle has vertices at (0, 3), (0, 5), (4, 5), and (4, 3). Find the coordinates of the vertices of the image of the rectangle after a translation 7 units left and 2 units down.

Getting Ready for Lesson 7-5

Simplify each expression.

75. $4^{\frac{1}{2}}$
76. $27^{\frac{2}{3}}$
77. $\left(\frac{1}{9}\right)^{-\frac{1}{2}}$
78. $16^{\frac{3}{4}}$
79. $125^{-\frac{2}{3}}$
80. $16^{\frac{1}{4}}$

Ditto p. 328 — ON YOUR OWN — KEY.

1. Product
2. Power
3. Quotient
4. Power
5. Quotient, Power
6. Power
7. Power, Quotient
8. Power, Quotient
9. Quotient.
10. Answers vary: $2\log 8$
11. 15%
12. $\log 14$
13. $\log_2 3$
14. $\log_4 \frac{\sqrt{t}}{s}$
15. $\log 972$
16. $\log 10$
17. $\log(ab^3)$
18. $\log \frac{m^4}{n}$
19. $\log \frac{\sqrt{xy}}{z^3}$
20. $\log xyz$
21. $\log \frac{r^7 t}{s}$
22. $\log \frac{ab}{6z}$
23. $\log_6 \sqrt[4]{5x}$
24. $\log_5 r - \log_5 s$
25. $3\log x + 5\log y$
26. $\log_3 7 + 2\log_3 (2x-3)$
27. $2\log a + 3\log b - 4\log c$
28. $\log 3 + \log m - 2\log n$.
29. $\log_4 5 + \frac{1}{2}\log_4 x$
30. $\log_7 22 + \log_7 x + \log_7 y + \log_7 z$
31. $3\log 2 + 3\log(x+1)$
32. $\log_2 5 + \log_2 a - 2\log_2 b$
33. $5 + 5\log_4 m + 5\log_4 n$
34. $2\log_3 2 + 2\log_3 x$
35. $\frac{1}{2}(\log 2 + \log x - \log y)$.
36. $\log(5\cdot 2) = \log 5 + \log 2$.
37. 102.2 db.
38. −2
39. −2
40. 1
41. 2
42. 3
43. 2
44. 1
45. 1
46. −4
47. 1.301
48. 1.380
49. 1.204
50. −0.097
51. 0.097
52. 1.477
53. 2.097
54. 0.176
55. −1.556
56. −0.602
57. 1.556
58. −1.398
59. Answers vary: When the base is the same, add exponents & logarithms.
60. True
61. False
62. True
63. False
64. False
65. False
66. True
67. False
68. True
69. A
70. $y = \pm\sqrt{\frac{x+1}{3}}$
71. $y = \frac{x-7}{5}$
72. $y = \sqrt[3]{\frac{x-10}{2}}$
73. $y = \pm\sqrt{5-x}$
74. $(-7,1)\ (-7,3)\ (-3,3)\ (-3,1)$
75. 2
76. 9
77. 3
78. 8
79. 0.04
80. 2