

Practice 8-3

Logarithmic Functions as Inverses

Write each equation in exponential form.

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|----------------------|------------------------------------|-----------------------------------|------------------------|
| 1. $\log_4 256 = 4$ | 2. $\log_7 1 = 0$ | 3. $\log_2 32 = 5$ | 4. $\log 10 = 1$ |
| 5. $\log_5 5 = 1$ | 6. $\log_8 \frac{1}{64} = -2$ | 7. $\log_9 59,049 = 5$ | 8. $\log_{17} 289 = 2$ |
| 9. $\log_{56} 1 = 0$ | 10. $\log_{12} \frac{1}{144} = -2$ | 11. $\log_2 \frac{1}{1024} = -10$ | 12. $\log_3 6561 = 8$ |

Write each equation in logarithmic form.

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|-----------------------------|------------------------------|----------------------------|-----------------------|
| 13. $9^2 = 81$ | 14. $25^3 = 625$ | 15. $8^3 = 512$ | 16. $13^2 = 169$ |
| 17. $2^9 = 512$ | 18. $4^5 = 1024$ | 19. $5^4 = 625$ | 20. $10^{-3} = 0.001$ |
| 21. $4^{-3} = \frac{1}{64}$ | 22. $5^{-2} = \frac{1}{25}$ | 23. $8^{-1} = \frac{1}{8}$ | 24. $11^0 = 1$ |
| 25. $6^1 = 6$ | 26. $6^{-3} = \frac{1}{216}$ | 27. $17^0 = 1$ | 28. $17^1 = 17$ |

29. A single-celled bacterium divides every hour. The number N of bacteria after t hours is given by the formula $\log_3 N = t$. After how many hours will there be 32 bacteria?

Evaluate each logarithm.

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|--------------------------|--------------------------|---------------------------|---------------------------|
| 30. $\log_2 16$ | 31. $\log_2 8$ | 32. $\log_2 4$ | 33. $\log_2 2$ |
| 34. $\log_2 1$ | 35. $\log_2 \frac{1}{2}$ | 36. $\log_2 \frac{1}{4}$ | 37. $\log_2 \frac{1}{8}$ |
| 38. $\log_{16} 16$ | 39. $\log_5 125$ | 40. $\log_{11} 121$ | 41. $\log 0.1$ |
| 42. $\log 1$ | 43. $\log_3 1$ | 44. $\log_6 216$ | 45. $\log_{12} 12$ |
| 46. $\log_{30} 30$ | 47. $\log 100,000$ | 48. $\log_3 \frac{1}{9}$ | 49. $\log_3 \frac{1}{27}$ |
| 50. $\log \frac{1}{100}$ | 51. $\log_4 32$ | 52. $\log_7 \frac{1}{49}$ | 53. $\log_{81} 9$ |

For each pH given, find the concentration of hydrogen ions $[H^+]$. Use the formula $pH = -\log[H^+]$.

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|---------|---------|---------|---------|
| 54. 7.2 | 55. 7.3 | 56. 8.2 | 57. 6.2 |
| 58. 5.6 | 59. 4.6 | 60. 7.0 | 61. 2.9 |

Graph each logarithmic function.

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|--------------------------------|-----------------------------|-----------------------------|
| 62. $y = \log x$ | 63. $y = \log_3 x$ | 64. $y = \log_6 x$ |
| 65. $y = \log_{\frac{1}{2}} x$ | 66. $y = \log_3(x + 1)$ | 67. $y = \log_2 x - 3$ |
| 68. $y = \log_6(x + 2)$ | 69. $y = \log_5(x - 4) + 1$ | 70. $y = \log_2(x - 3) + 1$ |

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7.3 Practice**2008–2009****#1 – 8: Write each logarithmic equation in exponential form.**

1) $\log_4 16 = 2$

2) $\log_3 81 = 4$

3) $\log_2 1 = 0$

4) $\log_9 3 = \frac{1}{2}$

5) $\log_5 \frac{1}{5} = -1$

6) $\log_8 4 = \frac{2}{3}$

7) $\log_5 5^2 = 2$

8) $\log_3 3 = 1$

#9 – 16: Write each exponential equation in logarithmic form.

9) $2^3 = 8$

10) $7^2 = 49$

11) $10^{-2} = 0.01$

12) $5^0 = 1$

13) $9^{3/2} = 27$

14) $4^{-1/2} = \frac{1}{2}$

15) $5^2 = 25$

16) $3^1 = 3$

#17 – 32: Evaluate each logarithm.

17) $\log_2 4$

18) $\log_3 27$

19) $\log_4 1$

20) $\log_3 81$

21) $\log_3 3$

22) $\log_5 25$

23) $\log_5 5^{2/3}$

24) $\log_2 \frac{1}{2}$

25) $\log_4 2$

26) $\log_9 3$

27) $\log_8 2$

28) $\log_8 4$

29) $\log_3(\log_5 5)$

30) $\log_2(\log_3 9)$

31) $\log_3(\log_3 27)$

32) $\log_2(\log_2 16)$

7.4 Practice**2008-2009****Rewrite the following expressions as a quotient of common logs.**

1. $\log_7 30$

2. $\log_3 8$

3. $\log_4 7$

Expand the following expressions:

4. $\log 3x^2$

5. $\log a^3b^2c$

6. $\log_7 \frac{2a}{b}$

7. $\log \sqrt{ab}$

8. $\log_3 \frac{3x^2}{y}$

9. $\log \sqrt[3]{5ab}$

Condense the following expressions:

10. $\log 6 - \log 4$

11. $\log 12 + \log x + \log y$

12. $2 \log c - \log b$

13. $\log_2 3 + 2\log_2 2 - \log_2 x$

14. $6 \log 2 + 2 \log x + 2 \log y$

15. $3(\log 4 + \log x)$

16. $10 \log x - (\log 3 + 2 \log y + 3 \log z)$

17. $\log_3 4 + 2 \log_3 x - \log_3 5$

18. $\frac{1}{2} \log_7 25 - \frac{1}{2} \log_7 9$

19. $2(\log 18 - \log 3) + \frac{1}{2} \log \frac{1}{16}$

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7.5 Practice**2008-2009****Evaluate the following expressions. (Express as a single number)**

1. $\ln e$

2. $\ln e^2$

3. $\ln 1$

4. $\ln e^3 + 1$

5. $\ln e + \ln e^4$

Expand the following expressions

6. $\ln\left(\frac{4ab}{c}\right)$

7. $\ln(ab^3c)$

8. $\ln\sqrt{a^3b}$

Condense the following expressions

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

10. $3\ln x - 5\ln y$

11. $2\ln x - (3\ln a + 4\ln b)$

Solve for x:

12. $e^x \cdot e^{3x} = 15$

13. $4(e^x) = 28$

14. $\frac{1}{2}e^x = 2$

15. $\ln x = 5$

16. $5\ln x - 4 = 1$

17. $3\ln(x+1) = 6$

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7.6 Practice

2008-2009

Solve the following equations for x:

1) $3^x = 15$

2) $4^x = 22$

3) $\log_3 x = -4$

4) $\log_7 x = 2$

5) $\log_4 5x = 2$

6) $\log x = -2$

7) $2^x - 5 = 10$

8) $10^x - 2 = 29$

9) $7(2^x) + 12 = 40$

10) $\log_6 4 + \log_6 x = 2$

11) $\log_5 3 + \log_5 x = 2$

12) $\log 7 + \log x = 4$

13) $\log(3x - 5) = 1$

14) $10^{5x} \cdot 10^{2x} = 5$

15) $4(2^{2x}) + 3 = 15$

$$16) 3^x \cdot 3^{3x} = 9$$

$$17) 2\log_7(3x - 1) + 4 = 8$$

$$18) 3\log x = 12$$

$$19) 2(3^x) + 1 = 23$$

$$20) \log_3 7 + \log_3 x = 4$$

$$21) \log_x 16 = 2$$

$$22) \log 5 - \log x = 2$$

$$23) 2(3^x) - 1 = 11$$

$$24) \log(2x + 2) = 3$$

$$*25) \log_2 5 + \log_2 x = \log_2 20 - \log_2 2$$

$$*26) \log_2 x + \log_2(x + 6) = 4$$

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7.6 (cont'd) Practice: Solving Logarithmic Equations

2009-2010

#1-6 Solve the following equations for x. Express your answer in log form.

1) $8^x = 12$

2) $4^x = 10$

3) $2^x = 7$

4) $3^x - 4 = 9$

5) $2(4^x) + 3 = 19$

6) $3(2^x) + 8 = 29$

#7-30 Solve the following equations for x.

7) $\log_4 x = 3$

8) $\log_x \frac{1}{9} = -2$

9) $\log_4 x = 2$

10) $\log_4 8 + \log_4 x = 3$

11) $\log_6 10 + \log_6 x = 2$

12) $\log 6 + \log x = 3$

13) $\log 8 + 3\log x = 3$

14) $2\log x - \log 4 = 0$

15) $\log 3x - \log 9 = 1$

16) $\log(x - 25) = 2$

17) $\log(2x + 5) = 3$

18) $\log(3x - 2) = 3$

$$19) \frac{1}{3}e^x = 5$$

$$20) e^{x+2} = 50$$

$$21) 4e^x = 10$$

$$22) \ln(3x + 4) = 5$$

$$23) 2\ln(3x - 1) = 6$$

$$24) 5\ln(3x - 2) = 20$$

$$25) \log x - \log 4 = -2$$

$$26) \log 6 - \log x = 2$$

$$27) 2\log(3x + 1) = 4$$

$$*28) \log x + \log(x + 3) = 1$$

$$*29) \log x + \log(x + 48) = 2$$

$$*30) \log\left(x + \frac{7}{10}\right) + \log x + 1 = 0$$

Chp 8 Test REview 2

- 1 Evaluate $\log_3 81$.
- 2 Tell whether the function $y = 3(2)^x$ shows growth or decay. Then graph the function.
- 3 Express $\log_2 256 - \log_2 4$ as a single logarithm. Simplify, if possible.
- 4 Express $\log_2 16^{-5}$ as a product. Simplify, if possible.
- 5 Simplify the expression $\log_5 125$.
- 6 Simplify $\log_7 x^3 - \log_7 x$.
- 7 Solve $\log_7 x^{10} - \log_7 x^8 = 3$.
- 8 Simplify $\ln e^{-6x}$.
- 9 Solve $\log_3 x = 2$.

Solve the given equation. If necessary, round to four decimal places.

- 10 $\log_2 7 + \log_2 a = \log_2 20$
- 11 $\log_5 (x + 2) - \log_5 12 = \log_5 144$
- 12 Evaluate the expression $\ln e^{19}$.
- 13 Evaluate the expression $e^{\ln 12}$.

Solve each equation.

- 14 $\log_{10} 5 + \log_{10} x = \log_{10} 25$

Practice 8-4**Properties of Logarithms**

For Exercises 1–2, use the formula $L = 10 \log \frac{I}{I_0}$.

- A sound has an intensity of $5.92 \times 10^{25} \text{ W/m}^2$. What is the loudness of the sound in decibels? Use $I_0 = 10^{-12} \text{ W/m}^2$.
- Suppose you decrease the intensity of a sound by 45%. By how many decibels would the loudness be decreased?

Assume that $\log 3 \approx 0.4771$, $\log 4 \approx 0.6021$, and $\log 5 \approx 0.6990$. Use the properties of logarithms to evaluate each expression. Do not use a calculator.

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|--------------|------------------------|------------------------|---------------|
| 3. $\log 12$ | 4. $\log 16$ | 5. $\log \frac{3}{5}$ | 6. $\log 0.8$ |
| 7. $\log 75$ | 8. $\log \frac{16}{5}$ | 9. $\log_6 1 - \log 1$ | 10. $\log 60$ |

Write each logarithmic expression as a single logarithm.

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|--|--|---|
| 11. $\log_5 4 + \log_5 3$ | 12. $\log_6 25 - \log_6 5$ | 13. $\log_2 4 + \log_2 2 - \log_2 8$ |
| 14. $5 \log_7 x - 2 \log_7 x$ | 15. $\log_4 60 - \log_4 4 + \log_4 x$ | 16. $\log 7 - \log 3 + \log 6$ |
| 17. $2 \log x - 3 \log y$ | 18. $\frac{1}{2} \log r + \frac{1}{3} \log s - \frac{1}{4} \log t$ | 19. $\log_3 4x + 2 \log_3 5y$ |
| 20. $5 \log 2 - 2 \log 2$ | 21. $\frac{1}{3} \log 3x + \frac{2}{3} \log 3x$ | 22. $2 \log 4 + \log 2 + \log 2$ |
| 23. $(\log 3 - \log 4) - \log 2$ | 24. $5 \log x + 3 \log x^2$ | 25. $\log_6 3 - \log_6 6$ |
| 26. $\log 2 + \log 4 - \log 7$ | 27. $\log_3 2x - 5 \log_3 y$ | 28. $\frac{1}{3}(\log_2 x - \log_2 y)$ |
| 29. $\frac{1}{2} \log x + \frac{1}{3} \log y - 2 \log z$ | 30. $3(4 \log t^2)$ | 31. $\log_5 y - 4(\log_5 r + 2 \log_5 t)$ |

Expand each logarithm.

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|------------------------|-----------------------------------|--------------------------|
| 32. $\log xyz$ | 33. $\log_2 \frac{x}{yz}$ | 34. $\log 6x^3y$ |
| 35. $\log 7(3x - 2)^2$ | 36. $\log \sqrt{\frac{2rst}{5w}}$ | 37. $\log \frac{5x}{4y}$ |
| 38. $\log_5 5x^{-5}$ | 39. $\log \frac{2x^2y}{3k^3}$ | 40. $\log_4 (3xyz)^2$ |

State the property or properties used to rewrite each expression.

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|---|--|--|
| 41. $\log 6 - \log 3 = \log 2$ | 42. $6 \log 2 = \log 64$ | 43. $\log 3x = \log 3 + \log x$ |
| 44. $\frac{1}{3} \log_2 x = \log_2 \sqrt[3]{x}$ | 45. $\frac{2}{3} \log 7 = \log \sqrt[3]{49}$ | 46. $\log_4 20 - 3 \log_4 x = \log_4 \frac{20}{x^3}$ |