Name _____ Date _____ Class _____

LESSON 7-4

# Practice B

## *Properties of Logarithms*

**Express as a single logarithm. Simplify, if possible.**

**1.** $\log_3 9 + \log_3 27$

**2.** $\log_2 8 + \log_2 16$

**3.** $\log_{10} 80 + \log_{10} 125$

**4.** $\log_6 8 + \log_6 27$

**5.** $\log_3 6 + \log_3 13.5$

**6.** $\log_4 32 + \log_4 128$

**Express as a single logarithm. Simplify, if possible.**

**7.** $\log_2 80 - \log_2 10$

**8.** $\log_{10} 4000 - \log_{10} 40$

**9.** $\log_4 384 - \log_4 6$

**10.** $\log_2 1920 - \log_2 30$

**11.** $\log_3 486 - \log_3 2$

**12.** $\log_6 180 - \log_6 5$

**Simplify, if possible.**

**13.** $\log_4 4^6$

**14.** $\log_5 5^{x-5}$

**15.** $7^{\log_7 30}$

**16.** $12^{\log_{12} 1}$

**17.** $\log_8 8^5$

**18.** $\log_3 9^4$

**Evaluate. Round to the nearest hundredth.**

**19.** $\log_{12} 1$

**20.** $\log_3 30$

**21.** $\log_5 10$

**Solve.**

**22.** The Richter magnitude of an earthquake, $M$, is related to the energy released in ergs, $E$, by the formula $M = \frac{2}{3}\log\left(\frac{E}{10^{11.8}}\right)$. Find the energy released by an earthquake of magnitude 4.2.

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## Practice A

### *Properties of Logarithms*

**Express as a single logarithm. Simplify, if possible.**

**1.** $\log_3 9 + \log_3 27$

$\log_3 (9 \cdot 27) = \log_3 243$

$3^x = 243$, so $x =$ 4

**2.** $\log_2 16 + \log_2 4$

$\log_2 (16 \cdot 4) = \log_2$ 64

$2^x =$ 64, so $x =$ 6

**3.** $\log_5 125 + \log_5 25$

$\log_5 (125 \cdot 25) = \log_5$ 3125

$5^x =$ 3125, so $x =$ 5

**4.** $\log_{10} 250 + \log_{10} 40$

$\log_{10} 10{,}000 = 4$

**5.** $\log_6 3 + \log_6 2$

$\log_6 6 = 1$

**6.** $\log_8 16 + \log_8 4$

$\log_8 64 = 2$

**Express as a single logarithm. Simplify, if possible.**

**7.** $\log_5 250 - \log_5 10$

$\log_5 25 = 2$

**8.** $\log_3 21 - \log_3 7$

$\log_3 3 = 1$

**9.** $\log_2 160 - \log_2 5$

$\log_2 32 = 5$

**10.** $\log_4 128 - \log_4 8$

$\log_4 16 = 2$

**11.** $\log_6 72 - \log_6 2$

$\log_6 36 = 2$

**12.** $\log_5 1000 - \log_5 8$

$\log_5 125 = 3$

**Simplify, if possible.**

**13.** $\log_6 36^2$

$2 \log_6 36$

$2 \cdot 2 =$ 4

**14.** $\log_5 5^4$

$4 \log_5 5$

4

**15.** $\log_2 8^3$

$3 \log_2 8$

9

**16.** $\log_3 3^4$

4

**17.** $\log_4 64^4$

12

**18.** $\log_8 8^2$

2

**Evaluate. Round to the nearest hundredth.**

**19.** $\log_5 13$

1.59

**20.** $\log_3 7$

1.77

**21.** $\log_8 21$

1.46

**Solve.**

**22.** The Richter magnitude of an earthquake, $M$, is related to the energy released in ergs, $E$, by the formula $M = \frac{2}{3}\log\left(\frac{E}{10^{11.8}}\right)$. Find the energy released by an earthquake of magnitude 6.8.

$10^{22}$ ergs





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## Practice B

### *Properties of Logarithms*

**Express as a single logarithm. Simplify, if possible.**

**1.** $\log_3 9 + \log_3 27$

$\log_3 243 = 5$

**2.** $\log_2 8 + \log_2 16$

$\log_2 128 = 7$

**3.** $\log_{10} 80 + \log_{10} 125$

$\log_{10} 10{,}000 = 4$

**4.** $\log_6 8 + \log_6 27$

$\log_6 216 = 3$

**5.** $\log_3 6 + \log_3 13.5$

$\log_3 81 = 4$

**6.** $\log_4 32 + \log_4 128$

$\log_4 4096 = 6$

**Express as a single logarithm. Simplify, if possible.**

**7.** $\log_2 80 - \log_2 10$

$\log_2 8 = 3$

**8.** $\log_{10} 4000 - \log_{10} 40$

$\log_{10} 100 = 2$

**9.** $\log_4 384 - \log_4 6$

$\log_4 64 = 3$

**10.** $\log_2 1920 - \log_2 30$

$\log_2 64 = 6$

**11.** $\log_3 486 - \log_3 2$

$\log_3 243 = 5$

**12.** $\log_6 180 - \log_6 5$

$\log_6 36 = 2$

**Simplify, if possible.**

**13.** $\log_4 4^6$

6

**14.** $\log_5 5^{x-5}$

$x - 5$

**15.** $7^{\log_7 30}$

30

**16.** $12^{\log_{12} 1}$

1

**17.** $\log_8 8^5$

5

**18.** $\log_9 9^4$

8

**Evaluate. Round to the nearest hundredth.**

**19.** $\log_{12} 1$

0

**20.** $\log_3 30$

3.10

**21.** $\log_5 10$

1.43

**Solve.**

**22.** The Richter magnitude of an earthquake, $M$, is related to the energy released in ergs, $E$, by the formula $M = \frac{2}{3}\log\left(\frac{E}{10^{11.8}}\right)$. Find the energy released by an earthquake of magnitude 4.2.

$10^{18.1}$ ergs





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## Practice C

### *Properties of Logarithms*

**Express as a single logarithm. Simplify, if possible.**

**1.** $\log_6 12 + \log_6 18$

$\log_6 216 = 3$

**2.** $\log_3 81 - \log_3 27$

$\log_3 3 = 1$

**3.** $\log_4 128 - \log_4 8$

$\log_4 16 = 2$

**4.** $\log_6 18 + \log_6 72$

$\log_6 1296 = 4$

**5.** $\log_5 3125 - \log_5 25$

$\log_5 125 = 3$

**6.** $\log_8 128 + \log_8 256$

$\log_8 32{,}768 = 5$

**7.** $\log_5 5 + \log_5 125$

$\log_5 625 = 4$

**8.** $\log_2 256 - \log_2 64$

$\log_2 4 = 2$

**9.** $\log_3 8019 - \log_3 99$

$\log_3 81 = 4$

**10.** $\log_8 80 + \log_8 51.2$

$\log_8 4096 = 4$

**11.** $\log_7 13.3 - \log_7 1.9$

$\log_7 7 = 1$

**12.** $\log_{10} 125 + \log_{10} 80$

$\log_{10} 10{,}000 = 4$

**Evaluate. Round to the nearest hundredth.**

**13.** $\log_8 8^6$

6

**14.** $2^{\log_2 8^x}$

$8^x$

**15.** $\log_2 16^5$

20

**16.** $\log_3 3^{(2x+1)}$

$2x + 1$

**17.** $\log_4 16^{(x-1)}$

$2x - 2$

**18.** $5^{\log_5 17}$

17

**19.** $\log_3 5^2$

2.93

**20.** $\log_5\left(\frac{1}{125}\right)^2$

$-6$

**21.** $\log_6\left(\frac{1}{6^4}\right)^3$

$-12$

**22.** $\log_4 20^2$

4.32

**23.** $\log_9 27^4$

6

**24.** $\log_2 10$

3.32

**Solve.**

**25.** Carmen has a painting presently valued at $5000. An art dealer told her the painting would appreciate at a rate of 6% per year. In how many years will the painting be worth $8,000?

**a.** Write a logarithmic expression.

$\log_{1.06} 1.6$

**b.** Simplify your expression.

8 years





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## Review for Mastery

### *Properties of Logarithms*

Use properties of logarithms to simplify logarithms.

The Product Property uses addition instead of multiplication.

**Product Property**

The logarithm of a product can be written as the sum of the logarithm of the numbers.

$$\log_b mn = \log_b m + \log_b n$$

where $m$, $n$, and $b$ are all positive numbers and $b \neq 1$

Simplify: $\log_8 4 + \log_8 16 = \log_8 (4 \cdot 16) = \log_8 64 = 2$

The bases must be the same for both logarithms.

Think: 8 to what power is equal to 64, or $8^? = 64$.

The Quotient Property uses subtraction instead of division.

**Quotient Property**

The logarithm of a quotient can be written as the logarithm of the numerator minus the logarithm of the denominator.

$$\log_b \frac{m}{n} = \log_b m - \log_b n$$

where $m$, $n$, and $b$ are all positive numbers and $b \neq 1$

Simplify: $\log_3 243 - \log_3 9 = \log_3 \left(\frac{243}{9}\right) = \log_3 27 = 3$

The bases must be the same for both logarithms.

Think: 3 to what power is equal to 27, or $3^? = 27$.

**Complete the steps to simplify each expression.**

**1.** $\log_6 54 + \log_6 4$

$\log_6 (54 \cdot 4)$

$\log_6 216$

3

**2.** $\log_2 128 - \log_2 8$

$\log_2 \left(\frac{128}{8}\right)$

$\log_2 16$

4

**3.** $\log_9 3 + \log_9 27$

$\log_9 (3 \cdot 27)$

$\log_9 81$

2