Name Mr. Ward Date _____ Class _____

LESSON 7-4

Reteach

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. $\log_9 3 + \log_9 27$

   $\log_9 (3 \cdot 27)$

   $\log_9 81$

   $= 2$

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Name Mr. Ward Date _____ Class _____

LESSON 7-4

Reteach

Properties of Logarithms (continued)

The Power Property uses multiplication instead of exponentiation.

Power Property

The logarithm of a power can be written as the product of the exponent and the logarithm of the base.

$$\log_b a^p = p \log_b a$$

for any real number p

where a and b are positive numbers and $b \neq 1$

Simplify: $\log_4 64^5 = 5 \log_4 64 = 5(3) = 15$

"Bring down" the exponent to multiply.

Think: 4 to what power is equal to 64, or $4^? = 64$.

Logarithms and exponents undo each other when their bases are the same.

Inverse Properties

The logarithm of b^x to the base b is equal to x.

$$\log_b b^x = x$$

The logarithm undoes the exponent when the bases are the same.

Simplify: $\log_7 7^{4x} = 4x$

The base of the log is 7 and the base of the exponent is 7.

b raised to the logarithm of x to the base b is equal to x.

$$b^{\log_b x} = x$$

The exponent undoes the logarithm when the bases are the same.

Simplify: $3^{\log_3 64} = 64$

The base of the exponent is 3 and the base of the log is 3.

Simplify each expression.

4. $\log_5 125^2$

   $2 \log_5 125$

   $2(3) = 6$

5. $\log_2 16^4$

   $4 \log_2 16$

   $4(4) = 16$

6. $\log_9 81^3$

   $3 \log_9 81$

   $3(2) = 6$

7. $\log_6 6^{5y}$

   $= 5y$

8. $4^{\log_4 75}$

   $= 75$

9. $2^{\log_2 3x}$

   $= 3x$

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Mr. Ward Answer Key

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1. $\log_5 50 + \log_5 62.5$
$\log_5 3125$
$= 5$

2. $\log 100 + \log 1000$
$\log 100{,}000$
$= 5$

3. $\log_3 3 + \log_3 27$
$\log_3 81$
$= 4$

4. $\log_4 320 - \log_4 5$
$\log_4 \frac{320}{5}$
$\log_4 64$
$= 3$

5. $\log 5.4 - \log 0.054$
$\log \frac{5.4}{0.054}$
$\log 100$
$= 2$

6. $\log_6 496.8 - \log_6 2.3$
$\log_6 \frac{496.8}{2.3}$
$\log_6 216$
$= 3$

7. $\log_8 8^2$
$= 2$

8. $\log_3 3^5$
$= 5$

9. $\log_7 49^3$
$3 \log_7 49$
$3(2) = 6$

10. $\log_{1/2} (0.25)^4$
$4 \log_{1/2} 0.25$
$4(2) = 8$

11. $\log_2 2^{\frac{x}{2}+5}$
$= \frac{x}{2} + 5$

12. $2.5^{\log_{2.5} 19}$
$= 19$

13. $\log_4 1024$
$= 5$

14. $\log_2 (0.5)^4$
$4 \log_2 (0.5)$
$4(-1) = -4$

20. $\log_8 4 + \log_8 16$
$\log_8 64$
$= 2$

21. $\log 2 + \log 5$
$\log 10$
$= 1$

22. $\log_{2.5} 3.125 + \log_{2.5} 5$
$\log_{2.5} 15.625$
$= 3$

23. $\log 1000 - \log 100$
$\log 10$
$= 1$

24. $\log_2 16 - \log_2 2$
$\log_2 8$
$= 3$

25. $\log_{1.5} 6.75 - \log_{1.5} 2$
$\log_{1.5} 3.375$
$= 3$

26. $\log_2 16^3$
$3 \log_2 16$
$3(4) = 12$

27. $\log 100^{0.1}$
$0.1 \log 100$
$0.1(2) = 0.2$

28. $\log_5 125^{1/3}$
$\frac{1}{3} \log_5 125$
$\frac{1}{3}(3) = 1$

29. $\log_3 3^{7+x}$
$= 7 + x$

30. $3^{\log_3 4.52}$
$= 4.52$

31. $\log_9 6561$
$= 4$