NAME _____ DATE _____ PERIOD _____

11-4

Study Guide

Logarithmic Functions

In the function $x = a^y$, y is called the **logarithm** of x. It is usually written as $y = \log_a x$ and is read "y equals the log, base a, of x." Knowing that if $a^u = a^v$ then $u = v$, you can evaluate a logarithmic expression to determine its logarithm.

Example 1 **Write $\log_7 49 = 2$ in exponential form.**

The base is 7 and the exponent is 2.
$7^2 = 49$

Example 2 **Write $2^5 = 32$ in logarithmic form.**

The base is 2, and the exponent or logarithm is 5.
$\log_2 32 = 5$

Example 3 **Evaluate the expression $\log_5 \frac{1}{25}$.**

Let $x = \log_5 \frac{1}{25}$.

$x = \log_5 \frac{1}{25}$

$5^x = \frac{1}{25}$ *Definition of logarithm.*

$5^x = (25)^{-1}$ $a^{-m} = \frac{1}{a^m}$

$5^x = (5^2)^{-1}$ $5^2 = 25$

$5^x = 5^{-2}$ $(a^m)^n = a^{mn}$

$x = -2$ *If $a^u = a^v$, then $u = v$.*

Example 4 **Solve each equation.**

a. $\log_6 (4x + 6) = \log_6 (8x - 2)$

$\log_6 (4x + 6) = \log_6 (8x - 2)$

$4x + 6 = 8x - 2$ *If $\log_b m = \log_b n$, then $m = n$.*

$-4x = -8$

$x = 2$

b. $\log_9 x + \log_9 (x - 2) = \log_9 3$

$\log_9 x + \log_9 (x - 2) = \log_9 3$

$\log_9 [x(x - 2)] = \log_9 3$ $\log_b mn = \log_b m + \log_b n$

$x^2 - 2x = 3$ *If $\log_b m = \log_b n$, then $m = n$.*

$x^2 - 2x - 3 = 0$

$(x - 3)(x + 1) = 0$ *Factor.*

$x - 3 = 0$ or $x + 1 = 0$ *Find the zeros.*

$x = 3$ or $x = -1$.

The log of a negative value does not exist, so the answer is $x = 3$.

NAME _____ DATE _____ PERIOD _____

11-4

Practice

Logarithmic Functions

Write each equation in exponential form.

1. $\log_3 81 = 4$ **2.** $\log_8 2 = \frac{1}{3}$ **3.** $\log_{10} \frac{1}{100} = -2$

Write each equation in logarithmic form.

4. $3^3 = 27$ **5.** $5^{-3} = \frac{1}{125}$ **6.** $\left(\frac{1}{4}\right)^{-4} = 256$

Evaluate each expression.

7. $\log_7 7^3$ **8.** $\log_{10} 0.001$ **9.** $\log_8 4096$

10. $\log_4 32$ **11.** $\log_3 1$ **12.** $\log_6 \frac{1}{216}$

Solve each equation.

13. $\log_x 64 = 3$ **14.** $\log_4 0.25 = x$

15. $\log_4 (2x - 1) = \log_4 16$ **16.** $\log_{10} \sqrt{10} = x$

17. $\log_7 56 - \log_7 x = \log_7 4$ **18.** $\log_5 (x + 4) + \log_5 x = \log_5 12$

19. ***Chemistry*** How long would it take 100,000 grams of radioactive iodine, which has a half-life of 60 days, to decay to 25,000 grams? Use the formula $N = N_0\left(\frac{1}{2}\right)^t$, where N is the final amount of the substance, N_0 is the initial amount, and t represents the number of half-lives.