NAME _____ DATE _____ PERIOD ____

# 9-2 Study Guide and Intervention

## Logarithms and Logarithmic Functions

### Logarithmic Functions and Expressions

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| **Definition of Logarithm with Base *b*** | Let $b$ and $x$ be positive numbers, $b \neq 1$. The logarithm of $x$ with base $b$ is denoted $\log_b x$ and is defined as the exponent $y$ that makes the equation $b^y = x$ true. |

The inverse of the exponential function $y = b^x$ is the **logarithmic function** $x = b^y$. This function is usually written as $y = \log_b x$.

| | |
|---|---|
| **Properties of Logarithmic Functions** | 1. The function is continuous and one-to-one.<br>2. The domain is the set of all positive real numbers.<br>3. The $y$-axis is an asymptote of the graph.<br>4. The range is the set of all real numbers.<br>5. The graph contains the point (1, 0). |

**Example 1** **Write an exponential equation equivalent to $\log_3 243 = 5$.**

$3^5 = 243$

**Example 2** **Write a logarithmic equation equivalent to $6^{-3} = \frac{1}{216}$.**

$\log_6 \frac{1}{216} = -3$

**Example 3** **Evaluate $\log_8 16$.**

$8^{\frac{4}{3}} = 16$, so $\log_8 16 = \frac{4}{3}$.

**Exercises**

**Write each equation in logarithmic form.**

1. $2^7 = 128$
2. $3^{-4} = \frac{1}{81}$
3. $\left(\frac{1}{7}\right)^3 = \frac{1}{343}$

**Write each equation in exponential form.**

4. $\log_{15} 225 = 2$
5. $\log_3 \frac{1}{27} = -3$
6. $\log_4 32 = \frac{5}{2}$

**Evaluate each expression.**

7. $\log_4 64$
8. $\log_2 64$
9. $\log_{100} 100{,}000$
10. $\log_5 625$
11. $\log_{27} 81$
12. $\log_{25} 5$
13. $\log_2 \frac{1}{128}$
14. $\log_{10} 0.00001$
15. $\log_4 \frac{1}{32}$