NAME _____ DATE _____ PERIOD _____

Integrated Math 3

Chapter 6 Section 1 Study Guide and Intervention

Logarithms and Logarithmic Functions

Logarithmic Functions and Expressions

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 $y = \log_b x$.

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 exponential form.

1. $\log_{15} 225 = 2$

2. $\log_3 \frac{1}{27} = -3$

3. $\log_4 32 = \frac{5}{2}$

Write each equation in logarithmic form.

4. $2^7 = 128$

5. $3^{-4} = \frac{1}{81}$

6. $\left(\frac{1}{7}\right)^3 = \frac{1}{343}$

7. $7^{-2} = \frac{1}{49}$

8. $2^9 = 512$

9. $64^{\frac{2}{3}} = 16$

Evaluate each expression.

10. $\log_4 64$

11. $\log_2 64$

12. $\log_{100} 100{,}000$

13. $\log_5 625$

14. $\log_{27} 81$

15. $\log_{25} 5$

16. $\log_2 \frac{1}{128}$

17. $\log_{10} 0.00001$

18. $\log_4 \frac{1}{32}$

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Chapter 6 Section 1 Study Guide and Intervention *(continued)*

Logarithms and Logarithmic Functions

Graphing Logarithmic Functions The function $y = \log_b x$, where $b \neq 1$, is called a **logarithmic function.** The graph of $f(x) = \log_b x$ represents a parent graph of the logarithmic functions. Properties of the parent function are described in the following table.

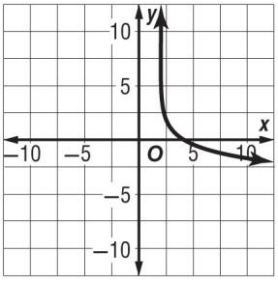
Parent function of Logarithmic Functions, $f(x) = \log_b x$	**1.** The function is continuous and one-to-one. **2.** The domain is the set of all positive real numbers. **3.** The *y*-axis is an asymptote of the graph. **4.** The range is the set of all real numbers. **5.** The graph contains the point (1, 0).

The graphs of logarithmic functions can be transformed by changing the value of the constants a, h, and k in the equation $f(x) = a \log_b (x - h) + k$.

Example: Graph $f(x) = -3 \log_{10} (x - 2) + 1$.

This is a transformation of the graph of $f(x) = \log_{10} x$.

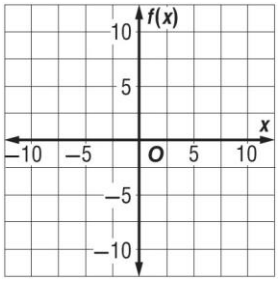
- $|a| = 3$: The graph expands vertically.
- $a < 0$: The graph is reflected across the *x*-axis.
- $h = 2$: The graph is translated 2 units to the right.
- $k = 1$: The graph is translated 1 unit up.



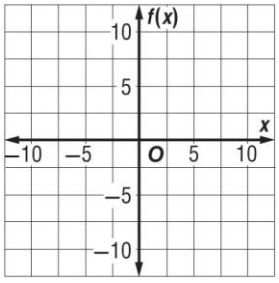
Exercises

Graph each function.

1. $f(x) = 4 \log_2 x$



2. $f(x) = 4 \log_3 (x - 1)$



3. $f(x) = 2 \log_4 (x + 3) - 2$