Lesson 7.3 Logarithmic Functions as Inverses

Essential Understanding: The exponential function $y = b^x$ is one-to-one, so its inverse $x = b^y$ is a function. To express "y as a function of x" for the inverse, write $y = \log_b x$.

Key Concept Logarithm

A **logarithm** base b of a positive number x satisfies the following definition.

For $b > 0$, $b \neq 1$, $\log_b x = y$ if and only if $b^y = x$.

You can read $\log_b x$ as "log base b of x." In other words, the logarithm y is the exponent to which b must be raised to get x.

Ex. What is the logarithm form of $100 = 10^2$?

Ex. What is the logarithm form of $81 = 3^4$?

1 What is the logarithmic form of $36 = 6^2$?

2 What is the logarithmic form of $1 = 3^0$

3 What is the logarithmic form of

$$\frac{8}{27} = (2/3)^3$$

Ex. What is the value of $\log_8 32$?

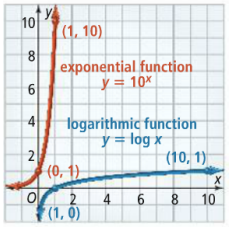
Ex. What is the value of $\log_5 125$?

4 What is the log value of $\log_4 32$?

5 What is the value of $\log_{16} 64$?

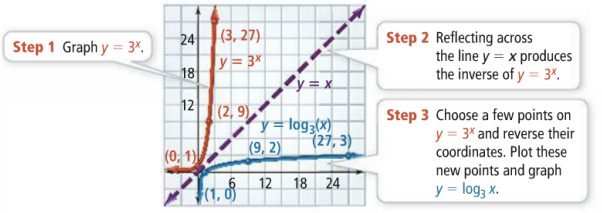
Exponential and logarithmic functions are inverses of each other. Therefore, the exponential function reflected over the equation y = x is the graph of the logarithmic function, as shown below.

The graph shows $y = 10^x$ and $y = \log x$.

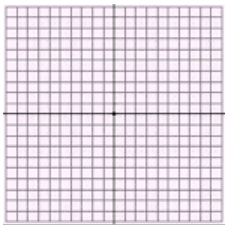


Ex. What is the graph of $y = \log_3 x$? Describe the domain and range and identify the y-intercept and the asymptote.

$y = \log_3 x$ is the inverse of $y = 3^x$.



Ex. What is the graph of $y = \log_4 x$? Describe the domain, range, y-intercept and asymptote.



Concept Summary Families of Logarithmic Functions

Parent functions:	$y = \log_b x, b > 0, b \neq 1$
Stretch ($\lvert a \rvert > 1$) Compression (Shrink) ($0 < \lvert a \rvert < 1$) Reflection ($a < 0$) in x-axis	$y = a \log_b x$
Translations (horizontal by h; vertical by k)	$y = \log_b (x - h) + k$
All transformations together	$y = a \log_b (x - h) + k$

Ex. How does the graph of $y = \log_4(x - 3) + 4$ compare to the graph of the parent function?