

Section 4.2: Logarithmic Functions

Key Topics: logarithmic function, properties, graphing techniques, common logarithm, natural logarithm

Logarithmic Function

For $x > 0$, $a > 0$, and $a \neq 1$,

$$y = \log_a x \text{ if and only if } \underline{\hspace{2cm}}.$$

The function $f(x) = \log_a x$ is called the **logarithmic function with base a** .

Write the exponential equation $5^3 = 125$ in logarithmic form.

Write the logarithmic equation $\log_6 x = 5$ in exponential form.

Basic Properties of Logarithms

For any base $a > 0$, with $a \neq 1$,

1. $\log_a a = \underline{\hspace{1cm}}$.
2. $\log_a 1 = \underline{\hspace{1cm}}$.
3. $\log_a a^x = \underline{\hspace{1cm}}$ for any real number x .
4. $a^{\log_a x} = \underline{\hspace{1cm}}$ for any $\underline{\hspace{1cm}}$.

Find the value of the logarithm $\log_{1/4} = 64$.

Properties of Exponential and Logarithmic Functions

Exponential Function $f(x) = a^x$	Logarithmic Function $f(x) = \log_a x$
1. The domain is _____, and the range is _____.	The domain is _____, and the range is _____.
2. The y-intercept is _____, and there is no _____.	The x-intercept is _____, and there is no _____.
3. The x-axis ($y = 0$) is the _____ asymptote.	The y-axis ($x = 0$) is the _____ asymptote.
4. The function is _____; that is, $a^u = a^v$ if and only if $u = v$.	The function is _____; that is, $\log_a u = \log_a v$ if and only if $u = v$.
5. The function is _____ if $a > 1$ and _____ if $0 < a < 1$.	The function is _____ if $a > 1$ and _____ if $0 < a < 1$.

Sketch the graph of $f(x) = \log_4 x$.

Common logarithm. $\log x =$ _____, for defined values.

Natural logarithm. $\ln x =$ _____, for defined values.

Summary of Basic Properties of Logarithms

Base $a > 0, a \neq 1$	Base 10	Base e
1. $\log_a a =$ _____	$\log 10 =$ _____	$\ln e =$ _____
2. $\log_a 1 =$ _____	$\log 1 =$ _____	$\ln 1 =$ _____
3. $\log_a a^x =$ _____	$\log 10^x =$ _____	$\ln e^x =$ _____
4. $a^{\log_a x} =$ _____	$10^{\log x} =$ _____	$e^{\ln x} =$ _____

Continuous Compound Interest_____ **Form**

$$A = \underline{\hspace{2cm}}$$

_____ **Form**

$$\ln \frac{A}{P} = \underline{\hspace{2cm}}$$