

Logarithms

What is a Logarithm?

- A logarithm looks like $\log_b(x) = y$ where $b > 0, b \neq 1$, and $x > 0$
- $\log_b(x) = y$ is said "log base b of x is y "
- We define a logarithm as follows:
 $\log_b y = x \Leftrightarrow y = b^x$
- We refer to b as the "base" of the logarithm \log_b . b is written as a subscript.

The Common Logarithm

- Often the logarithm with base 10 is referred to as the *common logarithm*; this is used so often that the subscript 10 is omitted (Confirm this with your course.):

$$\log_{10} x = \log x$$

The Natural Logarithm

- The logarithm with the base e . The number e is what $(1 + \frac{1}{n})^n$ approaches as $n \rightarrow \infty$. e is an irrational number approximately equal to 2.718. It is often referred to as the *natural logarithm*; this is very useful in Calculus, because e has some nice properties (Confirm this with your course.):

$$\log_e x = \ln x$$

Tips:

"ln" is pronounced "lawn."

The first symbol in "ln" is a lower case "l".

Laws of Logarithms

For $x, y, b \in \mathbb{R}, x, y, b > 0$ and $b \neq 1$

- $\log_b xy = \log_b x + \log_b y$
- $\log_b \left(\frac{x}{y}\right) = \log_b x - \log_b y$
- $\log_b x^n = n \log_b x$
- $\log_b \sqrt[n]{x} = \log_b x^{\frac{1}{n}} = \frac{1}{n} \log_b x$
- $\log_b b^x = x$
- $b^{\log_b x} = x$
- $\log_b b = 1$
- $\log_b 1 = 0$