

Chapter 5	Exponential and Logarithmic Functions
Section 2	Logarithmic Functions

Refer to the lecture notes from 3.5, Transformation of Functions, for the standard (basic) graphs of logarithmic functions. The same transformation techniques apply for graphing these functions.

The logarithmic function is the reverse of the exponential function, just as division is the reverse of multiplication. They cancel each other out. The general form for a log function is:

$$\log_a(x)=y \text{ (read this: log base a of x equals y)}$$

- "log" is the name of the function
- little subscript "a" is the base of the log
- "x" in the parenthesis is the expression (input) you are taking the log of
- "y" is the result (output)

Before getting into what is meant by "base", let's review exponential functions:

$$a^y=x$$

- "a" is the base
- "y" is the exponent
- "x" is the result

In an exponential function, the "base" is the number that you are multiplying by itself "y" times in order to get "x".

In a logarithmic function, "base" means the same thing, but is a lot more abstract. It is not as obvious what its purpose is.

It will be necessary to get comfortable with changing between the two forms – logarithmic and exponential.

### Types of Logarithms

Common – this is base 10. Often, the base is left off when it is 10:  $\log(y)=x$ .

Natural – this is base e ( $\approx 2.718$ ). Can be written as  $\log_e(y)=x$ , but is usually written as  $\ln(y)=x$ .

Familiarize yourself with the properties of logarithms.

Chapter 5	Exponential and Logarithmic Functions
Section 2	Logarithmic Functions

A common problem in dealing with log functions comes from not understanding some of the terminology.

First, let's get a better picture of what is meant by a function.

We are all familiar with the regular operations – multiplication, division, addition, and subtraction.

A function is like a higher order operation, higher even than multiplication.

The operation of a function is to take some input, an expression of some sort, process that input according to the function rules, and then produce an output or result.

Multiplication can be thought of as a function. It takes two inputs and produces an output. For example, if the inputs are 3 and 5, the output would be 15:  $3 \times 5 = 15$ .

Pay CLOSE attention to your order of operations!!!

It is often helpful to place parenthesis around the input of the function for clarity. Remember: this does NOT mean it is multiplication!

When evaluating functional expressions, you have to take care of the input of the function and clear the function FIRST before you can apply what is outside of the function.

When solving functional equations, you have to clear everything outside of the function first before you can clear the function using its reverse function. Using a reverse function clears the function and exposes the expression inside the function.

Functions are named, and usually abbreviated with three letters.