Concepts
Logarithmic Functions

Based on power point presentations by Pearson Education, Inc.

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Learning Objectives

1. Memorize the definition of the common logarithmic function.
2. Memorize the characteristics of the graphs of logarithmic functions.
3. Apply transformations to the common logarithmic function.
4. Graph the common logarithmic function and its transformations by hand.

NOTE: This lesson contains some examples. You can find more examples in the "Examples" document also located in the appropriate MOM Learning Materials folder.

1. The Common Logarithmic Function

The common logarithmic function is defined by ***f(x)* = log$_b$ *x***,

where *b* is any positive number but never equal to 1.

Domain: All positive real numbers or $(0, \infty)$

Examples:

$p(x) = \log_3 x$

$k(x) = \log_5 x$

$h(x) = \log_{10} x$ or $h(x) = \log x$

$g(x) = \log_e x$ or $g(x) = \ln x$

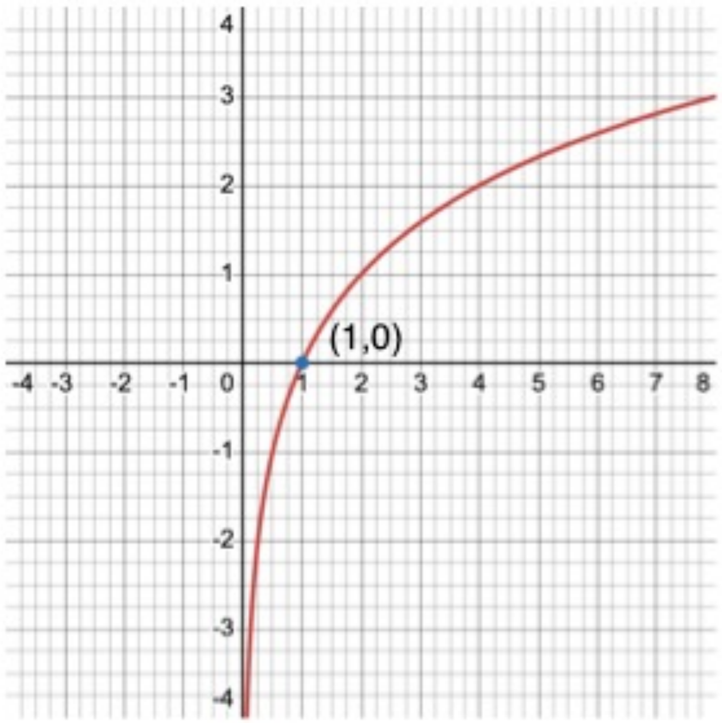
Special case of the common logarithmic function. It is sometimes called the natural logarithmic function. The irrational number ***e*** is its base.

2. Graphs of Logarithmic Functions (1 of 2)

The graphs of logarithmic functions consist of SMOOTH curves. There is a *vertical asymptote*. The graphs get closer and closer to it but never touch it. Below is the standard graph of any logarithmic function together with its asymptote.

Graphs of Logarithmic Functions (2 of 2)

The graph on the left is that of the common logarithmic function ***f(x)* = log$_b$ *x***.
The *y*-axis is always the *vertical asymptote*. We know its equation to be *x = 0*.
The *x*-intercept is always associated with the ordered pair (1, 0).



3. Transformations of the Common Logarithmic Functions

Transformations* of the basic logarithmic functions $\boldsymbol{f(x) = \log_b x}$ have the same type of graph, however, it can lie anywhere in the coordinate system (depending on the transformation).

*Remember, that transformations may consist of vertical shifts, horizontal shifts, vertical stretching and compressing, and reflections across the *x*- and *y*-axis.

The domains of transformations of logarithmic functions consist of all numbers that neither make the logarithm argument negative nor 0.

Note: Horizontal shifts WILL affect the location of the vertical asymptote!

4. Graph the Common Logarithmic Function and its Transformations by Hand

Graphing Strategy:

1. Find the equation of the *vertical asymptote.* Use a dashed line to graph it unless it is the *y*-axis.
2. Find and plot the point associated with the *x*-intercept.
3. Find and plot additional points. Best is to find two to three points to either side of the *x*-intercept.
4. Use the information obtained in the steps above to graph the function keeping in mind the shape of the graph of logarithmic functions.