**Section 3.2** (Logarithmic Functions)

In the last section we defined an **exponential function** f(x) = bx where b is a positive constant other than 1 and x is any real number. Let’s try to define the inverse of this function.

y = bx (switch x and y) => x = by (solve for y) => ???

The inverse function of the exponential function with base b is the **logarithmic function** with base b

f(x) = log b x is the logarithmic function with base b where y = log b x is equivalent to by = x

There are 2 ways to express the same equation here

Exponent

Exponent

Logarithmic Form: y = log b x Exponential Form: b y = x

Base

Base

Example: Write the following equations in equivalent exponential form

3 = log 7 x log 3 9 = y 3 = log b 64

Example: Write the following equations in equivalent logarithmic form

25 = x b3 = 27  

Given a logarithmic expression, you really ask yourself one question to evaluate the expression…

log 3 9 means 3 to what power gives me 9? => because 3**2** = 9 then log 3 9 = **2**

log 25 5 means 25 to what power gives me 5? => because 25 ?? = 5 then log 25 5 = \_\_\_\_

Examples: Evaluate:

log 4 64 log 5  log 36 6 log 3  log 9 9 log 8 1

Re-examining the inverse of the exponential function (f(x) = bx), we can now go a little further…

y = bx (switch x and y) => x = by (solve for y) => **log b x = y**

This gives us the inverse properties of logarithms log b bx = x and 

Examples: Evaluate log 7 78 and 

Considering that logarithmic functions are the inverses of exponential functions we know that their graphs should be symmetric about the line y = x…

Example: Graph f(x) = 3x and g(x) = log 3 x in the given coordinate system…

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| x | f(x) = 3x |
| -2 |  |
| -1 |  |
| 0 |  |
| 1 |  |
| 2 |  |

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| --- | --- |
| x | g(x) = log 3 x |
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Vertical Asymptote =>

**REVIEW CHARACTERISTICS OF GRAPHS** (pgs. 404-405)

Table 3.4 on pg. 405 discusses transformations of these logarithmic graphs

Examples: Use these properties to describe the graphs of f(x) log 5 (x + 3) and g(x) = 5 – log 2 x

**REVIEW ONLINE HW PROBLEMS 8-10**

In looking at the domain of logarithmic functions, consider that in y = log b x that we said b is a positive constant. So, if a positive number is raised to any power, the sign of the result is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The domain of a logarithmic function of the form f(x) = log b x is the set of all positive real numbers

Example: Find the domain of f(x) = log 4 (x – 5)

The logarithmic function with base 10 is called the *common logarithmic function* and the function

f(x) = log 10 x is usually expressed simply as f(x) = log x (the LOG button on calculators refers to the common log or log 10 x).

Example: Consider some properties of the common log (pg. 407) and use these properties to find log 106

Furthermore, the logarithmic function with base e is called the natural logarithmic function and is usually expressed as f(x) = ln x (see pgs. 408-410 for properties and note the inverse properties).

Examples: Review online HW problems 13-14.