§3.2 Logarithmic Functions and their Graphs

Logarithm :

For all real numbers y, and all positive numbers a and x, where $a \neq 1$:

$$y = \log_a x \qquad \text{if and only if} \quad x = a^y .$$

Note that your calculator has the ability to evaluate two types of logs.

Common Logs	**log (base 10)->**	**log x**
Natural Logs	**log (base e) ->**	**ln x**

Example 1:   Evaluating Logarithms on a Calculator

a) $\log_{10} 2.5$ b) $\log_{10}\left(\dfrac{1}{3}\right)$ c) $\ln 0.3$ d) $\ln(-1)$

Properties of Logarithms: (also true for natural logarithms)

1) $\log_a 1 = 0$ because $a^0 = 1$

2) $\log_a a = 1$ because $a^1 = a$

3) $\log_a a^x = x$ because $a^x = a^x$

4) $\log_a x = \log_a y$, then $x = y$

Graphs of the Form: $f(x) = \log_a x$

1) The point $(1, 0)$ is on the graph.
2) If $a > 1$, f is an increasing function; If $0 < a < 1$, f is a decreasing function.
3) The y-axis is a vertical asymptote.
4) The domain is $(0, \infty)$ and the range is $(-\infty, \infty)$.

Examples:

a) Graph $y = \log\ x$

b) Graph $y = \log_2(x-1)+3$