

## Definition of a Logarithm

$$(1) \quad y = \log_b x \text{ if and only if } x = b^y$$

*Essentially, the logarithm to the base  $b$  of a number  $x$  is the power which  $b$  must be raised to in order to obtain  $x$ .*

This immediately leads to the two very useful formulas

$$(2) \quad b^{\log_b x} = x \text{ and } \log_b b^x = x.$$

## Properties of Logarithms

Each of the properties of exponential functions has an analog for logarithmic functions.

- $\log_b(xy) = \log_b x + \log_b y$
- $\log_b(x/y) = \log_b x - \log_b y$
- $\log_b(x^r) = r \log_b x$
- $\log_b 1 = 0$ .

In other words, The logarithm of a product or quotient is the sum or difference of logarithms and the logarithm of a number to a power is the power times the logarithm of that number.