First Law

$$\log A + \log B = \log AB$$

Second Law

$$\log A - \log B = \log \frac{A}{B}$$

Third Law

$$\log A^n = n \log A$$

$$\log 1 = 0, \qquad \log_m m = 1$$

The logarithm of 1 to any base is always 0, and the logarithm of a number to the same base is always 1. In particular,

$$\log_{10} 10 = 1, \qquad \text{and} \qquad \log_e e = 1$$

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Logarithms and Log Properties

Definition

$y = \log_b x$ is equivalent to $x = b^y$

Example

$\log_5 125 = 3$ because $5^3 = 125$

Special Logarithms

$\ln x = \log_e x$ natural log

$\log x = \log_{10} x$ common log

where $e = 2.718281828\ldots$

Logarithm Properties

$\log_b b = 1$ $\log_b 1 = 0$

$\log_b b^x = x$ $b^{\log_b x} = x$

$\log_b \left(x^r \right) = r \log_b x$

$\log_b \left(xy \right) = \log_b x + \log_b y$

$\log_b \left(\dfrac{x}{y} \right) = \log_b x - \log_b y$

The domain of $\log_b x$ is $x > 0$