

# Precalculus

## Basic algebraic properties of the logarithm

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## Theorem (Properties of Logarithmic Functions)

*If  $a > 1$ , the function  $f(x) = \log_a x$  is a one-to-one, continuous, increasing function with domain  $(0, \infty)$  and range  $\mathbb{R}$ . If  $x, y, a, b > 0$  and  $r$  is any real number, then*

$$\textcircled{1} \log_a(xy) = \log_a x + \log_a y.$$

$$\textcircled{2} \log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y.$$

$$\textcircled{3} \log_a(x^r) = r \log_a x.$$

$$\textcircled{4} \log_a(x) = \log_b x \log_a b = \frac{\log_b x}{\log_b a} = \frac{\ln x}{\ln a}.$$