

5.5 Differentiation of Logarithmic Functions

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Now we will find derivatives of logarithmic functions and we will need rules for finding their derivatives.

Rule 3: Derivative of $\ln x$

$$\frac{d}{dx} \ln|x| = \frac{1}{x} \quad (x \neq 0)$$

Let's see if we can discover why the rule is as above.

First define the natural log function as follows: $y = \ln(x)$

Now rewrite in exponential form: $e^y = x$

Now differentiate implicitly:

$$e^y y' = 1$$
$$y' = \frac{1}{e^y} = \frac{1}{x}$$

Example 1: Find the derivative of $f(x) = x \ln x$.

Solution: This derivative will require the product rule.

$$f(x) = x \ln x$$

$$f'(x) = x \frac{1}{x} + \ln x \cdot 1$$

Product Rule:

(1st)(derivative of 2nd) + (2nd)(derivative of 1st)

$$f'(x) = 1 + \ln x$$