Calculus II

Arian DK

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6 Logarithmic Exponential and Other Transcedental Functions

6.1 The Natural Logarithmic Function: Differentiation

Definition of the Natural Logarithmic Function

The **natural logarithmic function** is defined by (fill in the function and bound)

$$\ln x \;=\; \int_1^x -\,dt, \qquad x > \quad .$$

The domain of the natural logarithmic function is the set of all positive real numbers.

Properties of the Natural Logarithmic Function

The natural logarithmic function has three important properties (cross out the word that is incorrect).

1. The domain is (,) and the range is (,).
2. The function is discrete/continuous, decreasing/increasing, and one-to-one.
3. The graph is convex/concave downward.

Logarithmic Properties

If a and b are positive numbers and n is rational, then the four properties below are true.

1. $\ln 1 =$
2. $\ln(ab) =$
3. $\ln(a^n) =$
4. $\ln\left(\frac{a}{b}\right) =$

Definition of e

The letter e denotes the positive real number such that

$$\ln e \;=\; \int_1^e \frac{1}{t}\,dt \;=\quad .$$

Derivative of the Natural Logarithmic Function

Let u be a differentiable function of x.

1.
$$\frac{d}{dx}\big[\ln x\big] = -, \qquad x > 0$$

2.
$$\frac{d}{dx}\big[\ln u\big] = -\frac{du}{dx} = -, \qquad u > 0$$

Derivative Involving Absolute Value

If u is a differentiable function of x such that $u \neq 0$, then

$$\frac{d}{dx}\left[\ln|u|\right] = \frac{u'}{u}.$$