

4.6 Derivatives of Exponential and Logarithmic Functions

Useful Thing to Know: $\lim_{h \rightarrow 0} \frac{e^h - 1}{h} = 1$

If u is a differentiable function of x , then we have

$$\frac{d}{dx}(e^u) = e^u * u'$$

For $a > 0$, and $a \neq 1$,

$$\frac{d}{dx}(a^u) = a^u \ln a * \frac{du}{dx}$$

If u is a differentiable function of x and $u > 0$,

$$\frac{d}{dx} \ln u = \frac{1}{u} * \frac{du}{dx}$$

If u is a differentiable function of x and $u > 0$, For $a > 0$ and $a \neq 1$,

$$\frac{d}{dx} \log_a u = \frac{1}{u \ln a} * \frac{du}{dx}$$

Examples:

1. What is the slope of the line tangent to the graph of $y = \frac{e^{-x}}{x+1}$ at $x = 1$?

- a. $-\frac{1}{e}$ **b. $-\frac{3}{4e}$** c. $-\frac{1}{4e}$ d. $\frac{1}{4e}$ e. $\frac{1}{e}$

2. If $f(x) = ae^{-ax}$ for $a > 0$, then $f'(x) =$

- a. e^{-ax} b. ae^{-ax} c. a^2e^{-ax} d. $-ae^{-ax}$ **e. $-a^2e^{-ax}$**

3. $\frac{d}{dx}(2^x) =$

- a. 2^{x-1} b. $(2^{x-1})x$ **c. $2^x \ln 2$** d. $2^{x-1} \ln 2$ e. $\frac{2x}{\ln 2}$