

**Section 3.9:**  
Derivatives of  
Exponential and Log  
Functions

Let's start with the natural log function. On your graphing calculator, let  $Y1=nDeriv(\ln x, x, x)$  and set up your table with  $x$  starting at 0 and the  $xstep$  be 1. Fill in the table below.

$x$	0	1	2	3	4	5	6	7	8	9	10
$y'$											

What is the relationship between the two numbers?

So...  $\frac{d}{dx}[\ln x] = \underline{\hspace{2cm}}$

## Derivatives of Exponential and Logs:

$$\frac{d}{dx}[\ln x] = \frac{1}{x}$$

$$\frac{d}{dx}[\log_a x] = \frac{1}{x \ln a}$$

$$\frac{d}{dx}[e^x] = e^x$$

$$\frac{d}{dx}[a^x] = a^x \ln a$$

Find  $dy/dx$ .

(1)  $y = 3^x + 2x^2$

(2)  $y = \ln(x^2 + 1)$

(3)  $y = x \ln(x)$

(4)  $y = [\ln(x)]^3$

(5)  $y = \log_4(3x^2 - 5x + 8)$

(6)  $y = \ln|\cos x|$

$$(7) \quad y = e^{2x-1}$$

$$(8) \quad y = e^{-3/x}$$

$$(9) \quad y = xe^x$$

$$(10) \quad y = \sin(e^x)$$

$$(11) \quad y = e^{\sin x}$$

$$(12) \quad y = \frac{e^{4x}}{x}$$

Use the properties of logs to simplify the expression before taking the derivative. Find  $dy/dx$ .

$$y = \ln(x\sqrt{3x-1})$$

$$y = \ln\left(\frac{x(x^2+3)^2}{\sqrt[3]{2x^2+4}}\right)$$

We can use this process to take the derivative of more complicated functions by using logarithmic differentiation. Basically, take the natural log of both sides of the function and then use implicit differentiation and log properties to find  $dy/dx$ .

$$y = \frac{(2x-1)^3}{\sqrt{x^2 + x + 1}}$$

Use logarithmic differentiation to find the derivatives of the following.

$$y = e^x$$

$$y = a^x$$

$$y = x^x$$

OK, that's it for derivative rules. Can you list all of them?