

Notes 3.4 Rules for Differentiation
Finding the Derivative of the Natural Exponential and Logarithmic Functions

Differentiation Rule for Natural Exponential Functions

$$\frac{d}{dx} [e^{f(x)}] = e^{f(x)} \cdot \frac{d}{dx} f(x)$$

Find the derivative of each of the following functions.

$f(x) = e^{\sin x}$ $f'(x) = e^{\sin x} \cdot \cos x$ $f'(x) = \cos x \cdot e^{\sin x}$	$f(x) = e^{2x+3}$ $\dot{f}(x) = e^{2x+3} \cdot (2)$ $\dot{f}(x) = 2e^{2x+3}$
$f(x) = 3e^{2x}$ $f'(x) = 3e^{2x} \cdot 2$ $f'(x) = 6e^{2x}$	$f(x) = (2x+3)e^{3x}$ $\dot{f} = (2) \cdot e^{3x} + (2x+3)e^{3x} \cdot 3$ $\dot{f} = e^{3x} [2 + 3(2x+3)]$ $\dot{f} = e^{3x} [2 + 6x+9]$ $\dot{f} = e^{3x} [6x+11]$
$f(x) = x^2 e^{2x}$ $\frac{d}{dx} f(x) = 2x \cdot e^{2x} + x^2 e^{2x} \cdot 2$ $= 2xe^{2x} [1+x]$	$f(x) = \sqrt{e^{2x-6}} = (e^{2x-6})^{\frac{1}{2}} = e^{\frac{x-3}{2}}$ $\frac{d}{dx} f(x) = e^{\frac{x-3}{2}} \cdot \frac{1}{2}$ $\frac{d}{dx} f(x) = e^{\frac{x-3}{2}}$

$$f(x) = \frac{e^{5x}}{3x^2}$$

$$\begin{aligned} f'(x) &= \frac{e^{5x}(5) \cdot 3x^2 - e^{5x} \cdot 6x}{(3x^2)^2} \\ &= \frac{3xe^{5x}[5x - 2]}{9x^4} \\ &= \frac{e^{5x}[5x - 2]}{3x^3} \end{aligned}$$

Differentiation Rule for Natural Logarithmic Functions

$$\frac{d}{dx} [\ln(f(x))] = \frac{\frac{df}{dx}}{f(x)}$$

Find the derivative of each of the following functions.

$$f(x) = \ln(2x - 3)$$

$$f'(x) = \frac{2}{2x-3}$$

$$f(x) = \ln(3x^2 + 2x)$$

$$f'(x) = \frac{6x+2}{3x^2+2x}$$

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

$$\frac{df}{dx} = \frac{-\sin x}{\cos x}$$

$$\frac{df}{dx} = -\tan x$$

$$f(x) = \ln \sqrt{2x-4} = \ln(2x-4)^{1/2}$$

$$f' = \frac{\frac{1}{2}(2x-4)^{-1/2} (2)}{(2x-4)^{1/2}}$$

$$f' = \frac{1}{2x-4}$$