3.9 Logarithmic/Exponential Derivatives

Objectives:

- I can find the derivative of an exponential function

- I can find the derivative of a logarithmic function

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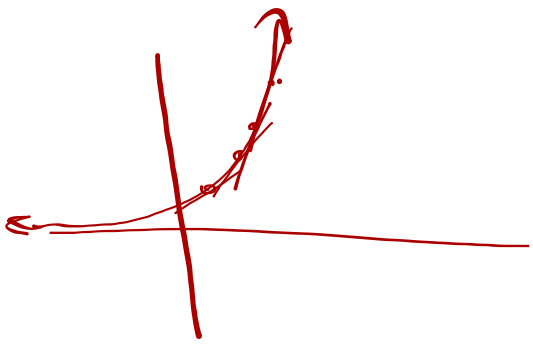
What is the derivative of $y = e^x$ $y' = e^x$

Analytically:

$$\lim_{h \to 0} \frac{e^{x+h} - e^x}{h}$$

Graphically:



Numerically:

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Rule Sheet

58. $\frac{d}{dx}(e^x) = e^x$

59. $\frac{d}{dx}(a^x) = a^x \ln a$

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$\ln = \log_e$

Find the derivative of y=lnx

$e^y = x$

$e^y \frac{dy}{dx} = 1$

$\frac{dy}{dx} = \frac{1}{e^y}$

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

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Rule Sheet

56. $\frac{d}{dx}(\ln x) = \frac{1}{x}, x > 0$

57. $\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}, x > 0$

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Find the derivative. State any domain restrictions.

$f(x) = 2e^{2x}$

$f'(x) = 2 \cdot e^{2x} \cdot 2$

$= 4e^{2x}$

$y = e^{\frac{1x}{-2}}$ → $-\frac{1}{2}x$

$y' = e^{-\frac{x}{2}} \cdot -\frac{1}{2}$

$= -\frac{1}{2} e^{-\frac{x}{2}}$

or $\frac{-e^{-\frac{x}{2}}}{2}$

$g(x) = 3^{4x}$

$g'(x) = 3^{4x} \cdot \ln 3 \cdot 4$

$g'(x) = 3^{4x} \cdot 4 \ln 3$

$g'(x) = 3^{4x} \cdot \ln 3^4$

$= 3^{4x} \cdot \ln 81$

$= (3^4)^x \cdot \ln 81$

$= 81^x \cdot \ln 81$

$y = xe^{2x}$

$y' = x \cdot e^{2x} \cdot 2 + e^{2x}(1)$

$y' = 2xe^{2x} + e^{2x}$

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Find the derivative. State any domain restrictions.

$y = 4^{x^2}$

$y' = 4^{x^2} \cdot \ln 4 \cdot 2x$

$= 4^{x^2} \cdot 2x \ln 4$

$= 4^{x^2} \cdot x \ln 4^2$

$= 4^{x^2} \cdot x \ln 16$

$g(x) = \ln\left(\frac{1}{x}\right)$

x^{-1} -2 $-x$ $\frac{1}{x^2}$

$g'(x) = \frac{1}{(1/x)} \cdot -\frac{1}{x^2}$

$= x \cdot -\frac{1}{x^2} = -\frac{x}{x^2}$

$= -\frac{1}{x}$

$y = \ln(x^2)$

$y = 2 \ln x$

$y' = 2 \cdot \frac{1}{x}$

$y' = \frac{2}{x}$

$y = \log_6(x^3 + 2x - 1)$

$y' = \frac{1}{(x^3+2x-1)\ln 6} \cdot \frac{3x^2+2}{1}$

$y' = \frac{3x^2+2}{(x^3+2x-1)\ln 6}$

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Find the derivative. State any domain restrictions.

$y = \frac{e^x}{\ln x}$

$y' = \frac{\ln x \cdot e^x - e^x \cdot \frac{1}{x}}{\ln^2 x}$

$y' = \frac{x \ln x \cdot e^x - e^x}{x \ln^2 x}$

$y' = \frac{\frac{x \ln x \cdot e^x}{x} - \frac{e^x}{x}}{\ln^2 x} = \frac{x \ln x \cdot e^x - e^x}{x} \cdot \frac{1}{\ln^2 x}$

$y = x \ln x$

$= \frac{x \ln x \cdot e^x - e^x}{x \ln^2 x}$

$y = e^{2 \ln 6}$

$y' = 0$

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

$f(x) = x \ln 2$

$f'(x) = \ln 2$

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Find the derivative. State any domain restrictions.

$y = \log_6 \sqrt[3]{x}$

$y = \ln(\cos x)$ $x > 0$

$y' = \frac{1}{\cos x} \cdot -\sin x$

$= \frac{-\sin x}{\cos x} = -\tan x$

$y = \ln(\ln x)$

$y = e^{\tan 2x}$

$f(x) = \sec^{-1}(e^x)$

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$f(x) = \sec^{-1}(e^x)$

$f'(x) = \frac{1}{|e^x|\sqrt{(e^x)^2 - 1}} \cdot e^x$

$f'(x) = \frac{e^x}{|e^x|\sqrt{e^{2x} - 1}} = \frac{1}{\sqrt{e^{2x} - 1}}$

Find the equation of the line tangent to $y = 2e^x$ at x=1

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Find the equation of the line tangent to $y = x^2$ at x=e

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