4.4 Day 1 Exponential and Log Derivatives

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$y = e^x$ $\boxed{y' = e^x}$ $\boxed{y = e^u \quad y' = e^u \cdot u'}$

$\boxed{y' = e^x \cdot \underbrace{\ln e}_{1}}$

example $y = e^{x^2}$ $\frac{dy}{dx} = e^{x^2} \cdot 2x$

$y = e^{\sin x}$ $y' = e^{\sin x} \cdot \cos x$

$y = \ln x$ iff $e^y = x$

$x = e^y$

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

$\boxed{\frac{d}{dx}\ln x = \frac{1}{x} \qquad \frac{d}{dx}\ln u = \frac{1}{u} \cdot u'}$

example: $f(x) = \ln(3x)$ $f'(x) = \frac{1}{3x} \cdot 3 = \frac{1}{x}$

Exponential

$y = a^x$

$a =$ constant

$x =$ is a variable/function

$\ln y = \ln a^x$

$\ln y = x \ln a$ constant

$\star$ $(y)\frac{1}{y} \cdot y' = \ln a \cdot y$

$y' = y \ln a$

$y' = a^x \ln a$

$\ln 2$ (constant)

$\frac{1}{\ln 2}$ constant

$y = 2 \cdot x$ $y' = 2$

$y' = 2 \cdot \frac{d}{dx} x$

$\frac{d}{dx} x \cdot \ln a$

$= \ln a(1) + x(0)$

$$\boxed{\frac{d}{dx}a^x = a^x \cdot \ln a \qquad \frac{d}{dx}a^u = a^u \cdot \ln a \cdot u'}$$

Ex:

$y = 4^x$

$y' = 4^x \cdot \ln 4$

or

$y = 4^x$

$\ln y = \ln 4^x$

$\ln y = x \ln 4$

$\frac{y}{1} \cdot \frac{1}{y} \cdot y' = \ln 4 \cdot \frac{y}{1}$

$y' = y \ln 4$

$= 4^x \ln 4$

you try... $y = 3^{\sin x}$

$$\boxed{y' = 3^{\sin x} \ln 3 \cos x}$$

$\frac{d}{dx}a^u = a^u \cdot \ln a \cdot u'$

$\frac{dy}{dx} = 3^{\sin x} \cdot \ln 3 \cdot \cos x$

$y = \log_2 x$

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

constant

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

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

change of base

$\log_b a = \frac{\log_c a}{\log_c b} = \frac{\ln a}{\ln b}$

fun precal fact