October 6, 2025

National Noodle Day

Today in History:

First U.S. Train robbery (1866)

Jane Eyre is published (1847)

Number of the Day: 1833

1833 = 3 x 13 x 47

1833 is the start of the first run of exactly 7 consecutive odd composite numbers.

Fun Fact:

The Beatles performed their first U.S. concert in Carnegie Hall.

Quote of the Day:

"Just Play. Have Fun. Enjoy the Game."

Michael Jordan

Today's Weather:

Sun and clouds mixed, high 81°

Math 121

Quiz #21

Find $f'(x)$ for

$$f(x) = x^2 \arctan(e^x)$$

$$f'(x) = x^2 \left(\frac{e^x}{1+(e^x)^2} \right) + 2x \, \text{ARCTAN}(e^x)$$

MPOD 21
#3

$$y = \text{ARCSIN}\left(\frac{x}{3}\right)$$

$$\frac{dy}{dx} = \frac{1}{\sqrt{1-\left(\frac{x}{3}\right)^2}} \cdot \frac{1}{3}$$

$$= \frac{1}{\sqrt{1-\frac{x^2}{9}}} \cdot \frac{1}{3}$$

$$= \frac{1}{\sqrt{1-\frac{x^2}{9}}} \frac{1}{\sqrt{9}}$$

$$= \frac{1}{\sqrt{\left(1-\frac{x^2}{9}\right)9}} = \frac{1}{\sqrt{9-x^2}}$$

*4 $\quad y = \sec(2x) - \operatorname{arcsec}\left(\frac{x}{2}\right)$

$$\frac{dy}{dx} = 2\sec(2x)\tan(2x) - \frac{1}{\left|\frac{x}{\cancel{2}}\right|\sqrt{\left(\frac{x}{2}\right)^2 - 1}} \cdot \frac{1}{\cancel{2}}$$

$$= 2\sec(2x)\tan(2x) - \frac{1}{|x|\sqrt{\frac{x^2}{4} - \frac{4}{4}}}$$

$$= 2\sec(2x)\tan(2x) - \frac{1}{|x|\sqrt{\frac{x^2-4}{4}}}$$

$$= 2\sec(2x)\tan(2x) - \frac{2}{|x|\sqrt{x^2-4}}$$

WE KNOW

$y = e^x \qquad \frac{dy}{dx} = e^x$

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

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

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

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

$f(x) = \ln x \qquad f'(x) = \frac{1}{x}$

$f(x) = \ln(\text{STUFF}) \qquad f'(x) = \frac{\text{STUFF}'}{\text{STUFF}}$

EXAMPLE

$f(x) = \ln(x^2+3x+5)$

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

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

$$f'(x) = x^{\cancel{2}}\left(\frac{1}{\cancel{x}}\right) + 2x \ln x$$

$$= x + 2x \ln x$$

$y = \ln(x^2) \qquad y' = \frac{2\cancel{x}}{x^{\cancel{2}}} = \frac{2}{x}$

$y = 2\ln x \qquad y' = 2\left(\frac{1}{x}\right)$

$\underline{y = b^x} \qquad \underline{\ln y} = \ln b^x = \underline{x \ln b}$

$\frac{1}{y}\frac{dy}{dx} = \ln b \qquad \frac{dy}{dx} = y \ln b$

$$y = b^x \qquad \frac{dy}{dx} = b^x \ln b$$

$$y = b^{\text{JUNK}} \qquad \frac{dy}{dx} = b^{\text{JUNK}} \ln b \cdot \text{JUNK}'$$

EXAMPLE

$$y = 3^x \qquad \frac{dy}{dx} = 3^x \ln 3$$

$$y = 4^{5x} \qquad \frac{dy}{dx} = 4^{5x} \ln 4 \cdot 5$$

$$y = 5^{\sin x} \qquad \frac{dy}{dx} = 5^{\sin x} (\ln 5)(\cos x)$$

$$\underline{\ln x} = \log_e x$$

$$\underline{y = \log_b x} \iff \boxed{b^y = x}$$

$$b^y \ln b \frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{b^y \ln b} = \frac{1}{x \ln b}$$

$$y = \log_b x \qquad \frac{dy}{dx} = \frac{1}{x \ln b}$$

$$y = \log_b(\ ) \qquad \frac{dy}{dx} = \frac{1}{\ \ln b} \cdot \ '$$

$$y = \log_3 x \qquad \frac{dy}{dx} = \frac{1}{x \ln 3}$$

EXAMPLE

$$y = \ln\left(\frac{(3x^4+4x^3+7)^5 (2x+1)^6}{\sqrt{5x+\sin x}}\right)$$

$$y = 5\ln(3x^4+4x^3+7) + 6\ln(2x+1) - \frac{1}{2}\ln(5x+\sin x)$$

$$\frac{dy}{dx} = 5\,\frac{12x^3+12x^2}{3x^4+4x^3+7} + 6\,\frac{2}{2x+1} - \frac{1}{2}\,\frac{5+\cos x}{5x+\sin x}$$

$$\ln y = \ln\frac{(2x^2+x+5)^5(x^7-x^6)^3}{(\cos x+e^x)^2}$$

$$\ln y = 5\ln(2x^2+x+5) + 3\ln(x^7-x^6) - 2\ln(\cos x+e^x)$$

$$\frac{1}{y}\frac{dy}{dx} = 5\,\frac{4x+1}{2x^2+x+5} + 3\,\frac{7x^6-6x^5}{x^7-x^6} - 2\,\frac{-\sin x+e^x}{\cos x+e^x}$$

$$\frac{dy}{dx} = \underline{\underline{y}}\left(5\,\frac{4x+1}{2x^2+x+5} + 3\,\frac{7x^6-6x^5}{x^7-x^6} - 2\,\frac{-\sin x+e^x}{\cos x+e^x}\right)$$

$$= \left(\frac{(2x^2+x+5)^5(x^7-x^6)^3}{(\cos x+e^x)^2}\right)\left(5\,\frac{4x+1}{2x^2+x+5} + 3\,\frac{7x^6-6x^5}{x^7-x^6} - 2\,\frac{-\sin x+e^x}{\cos x+e^x}\right)$$

$\underline{y = x^x}$ LOG. DIFF.

WHAT I KNOW:

$y = x^n \qquad \frac{dy}{dx} = n x^{n-1}$

$y = b^x \qquad \frac{dy}{dx} = b^x \ln b$

$\underline{y = x^x}$

$\left[\ln y = \ln x^x = \underline{x \ln x}\right]$

$\frac{1}{y}\frac{dy}{dx} = \cancel{x}\left(\frac{1}{\cancel{x}}\right) + \ln x$

$\frac{dy}{dx} = y(1 + \ln x)$

$\frac{dy}{dx} = x^x(1 + \ln x)$

$\underline{y = x^{\sin x}}$

$\ln y = \ln x^{\sin x} = \underline{\sin x}\ \underline{\ln x}$

$\frac{1}{y}\frac{dy}{dx} = \sin x\left(\frac{1}{x}\right) + (\ln x)(\cos x)$

$\frac{dy}{dx} = y\left[\frac{\sin x}{x} + (\ln x)(\cos x)\right]$

$\frac{dy}{dx} = x^{\sin x}\left[\frac{\sin x}{x} + (\ln x)(\cos x)\right]$

$f(x)$	$f'(x)$
e^x	e^x
$\ln x$	$\frac{1}{x}$
e^{JUNK}	$e^{\text{JUNK}} \cdot \text{JUNK}'$
$\ln(\text{JUNK})$	$\frac{\text{JUNK}'}{\text{JUNK}}$
b^x	$b^x \ln b$
b^{JUNK}	$b^{\text{JUNK}}(\ln b)(\text{JUNK})'$
$\text{LOG}_b x$	$\frac{1}{x \ln b}$
$\text{LOG}_b(\text{JUNK})$	$\frac{1}{\text{JUNK} \ln b} \cdot \text{JUNK}'$

$(\text{FUNCTION})^{\text{FUNCTION}}$ MUST USE LOG DIFF.