October 7, 2025

Bathtub Day

Today in History:

East Germany was created (1949)

Arnold Schwarzenegger becomes California governor (2003)

Number of the Day: 1570

1570 = 2 x 5 x 157

1570 is a divisor of $13^{12} - 1$

Fun Fact:

In the movie *The Wizard of Oz*, Toto the dog's salary was $125 per week, Judy Garland's was $500 a week.

Quote of the Day:

Can you do Division? Divide a loaf by a knife - what's the answer to *that*?

~Lewis Carroll, *Through the Looking Glass*

Today's Weather:

Rainshowers in the morning with thunderstorms in the afternoon, high 70^{o}

Math 121

Quiz #22

Find $f'(x)$ for

$$f(x) = 2\ln(\sin(3x) - e^x) - 4^x + 5$$

$$f'(x) = 2\,\frac{3\cos(3x) - e^x}{\sin(3x) - e^x} - 4^x \ln 4$$

mpod 22

#14

$$y = \sqrt[5]{\frac{x-1}{x+1}} = \left(\frac{x-1}{x+1}\right)^{\frac{1}{5}}$$

$$\frac{dy}{dx} = \frac{1}{5}\left(\frac{x-1}{x+1}\right)^{-\frac{4}{5}}\left(\frac{(x+1)-(x-1)}{(x+1)^2}\right)$$

$$\ln y = \ln\left(\frac{x-1}{x+1}\right)^{\frac{1}{5}} = \frac{1}{5}\left(\ln(x-1) - \ln(x+1)\right)$$

$$\frac{1}{y}\frac{dy}{dx} = \frac{1}{5}\left(\frac{1}{x-1} - \frac{1}{x+1}\right)$$

$$\frac{dy}{dx} = \frac{1}{5}\left(\frac{1}{x-1} - \frac{1}{x+1}\right)\left(\frac{x-1}{x+1}\right)^{\frac{1}{5}}$$

#7 $y = \ln\left(\frac{1+x}{1-x}\right) = \ln(1+x) - \ln(1-x)$

$$\frac{dy}{dx} = \frac{1}{1+x} + \frac{1}{1-x}$$

#6 $y = x^{\sin x}$

$$\ln y = \ln x^{\sin x} = (\sin x)(\ln x)$$

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

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

#11 $y = \ln(\ln(\ln x))$

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

#5 $y = e^{x \sin x}$

$$\frac{dy}{dx} = (x\cos x + \sin x)e^{x \sin x}$$

Pg 197 #27

$s(t) = 3^{9t}$

$s'(t) = 3^{9t} \ln 3 \cdot (9)$

$t = 2$

$s(2) = 3^{18}$

$(2, 3^{18})$

$$s'(2) = 3^{18}(\ln 3)\,9 = 3^{20}\ln 3$$

$$y - 3^{18} = 3^{20}\ln 3\,(t-2)$$

HYPERBOLIC TRIG

$$\sinh x = \frac{e^x - e^{-x}}{2} \qquad \cosh x = \frac{e^x + e^{-x}}{2}$$

$$\cosh^2 x - \sinh^2 x = 1$$

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① $y = \sinh x = \dfrac{e^x - e^{-x}}{2}$

$$\frac{dy}{dx} = \frac{e^x + e^{-x}}{2} = \cosh x$$

$$y = \sinh x \qquad \frac{dy}{dx} = \cosh x$$

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② $y = \cosh x = \dfrac{e^x + e^{-x}}{2}$

$$\frac{dy}{dx} = \frac{e^x - e^{-x}}{2} = \sinh x$$

$$y = \cosh x \qquad \frac{dy}{dx} = \sinh x$$

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③ $y = \tanh x = \dfrac{\sinh x}{\cosh x}$

$$\frac{dy}{dx} = \frac{\cosh x \cosh x - \sinh x \sinh x}{\cosh^2 x} = \frac{\cosh^2 x - \sinh^2 x}{\cosh^2 x}$$

$$= \frac{1}{\cosh^2 x} = \operatorname{sech}^2 x$$

$y = \tanh x \qquad \frac{dy}{dx} = \operatorname{sech}^2 x$

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(4) $y = \coth x = \frac{\cosh x}{\sinh x}$

$$\frac{dy}{dx} = \frac{(\sinh x)(\sinh x) - (\cosh x)(\cosh x)}{\sinh^2 x}$$

$$= \frac{\sinh^2 x - \cosh^2 x}{\sinh^2 x} = -\operatorname{csch}^2 x$$

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(5) $y = \operatorname{sech} x = \frac{1}{\cosh x} = (\cosh x)^{-1}$

$$\frac{dy}{dx} = -(\cosh x)^{-2} \sinh x = -\frac{\sinh x}{\cosh^2 x}$$

$$= -\frac{\sinh x}{\cosh x} \cdot \frac{1}{\cosh x} = -\tanh x \operatorname{sech} x$$

(6) $y = \operatorname{csch} x \qquad \frac{dy}{dx} = -\coth x \operatorname{csch} x$

$f(x)$	$f'(x)$
$\sin x$	$\cos x$
$\cos x$	$-\sin x$
$\tan x$	$\sec^2 x$
$\cot x$	$-\csc^2 x$
$\sec x$	$\sec x \tan x$
$\csc x$	$-\csc x \cot x$

$\sinh x$	$\cosh x$
$\cosh x$	$\sinh x$
$\tanh x$	$\operatorname{sech}^2 x$
$\coth x$	$-\operatorname{csch}^2 x$
$\operatorname{sech} x$	$-\operatorname{sech} x \tanh x$
$\operatorname{csch} x$	$-\operatorname{csch} x \coth x$

$y = \operatorname{arcsinh} x \quad (\sinh^{-1} x)$

$\sinh y = \sinh(\operatorname{arcsinh} x)$

$$\boxed{\sinh y = x}$$

$$(\cosh y)\frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{\cosh y} = \frac{1}{\sqrt{1+x^2}}$$

$$\cosh^2 y - \sinh^2 y = 1$$

$$\cosh^2 y = 1 + \sinh^2 y$$

$$\cosh^2 y = 1 + x^2$$

$$\cosh y = \sqrt{1+x^2}$$

RECALL

$y = \text{ARCSIN}\, x$ $\qquad \dfrac{dy}{dx} = \dfrac{1}{\sqrt{1-x^2}}$

$y = \text{ARC}\sinh x$ $\qquad \dfrac{dy}{dx} = \dfrac{1}{\sqrt{1+x^2}}$

$y = \text{ARC}\cosh x \qquad (\cosh^{-1} x)$

$$\cosh y = \cosh(\text{ARC}\cosh x)$$

$$\boxed{\cosh y = x}$$

$$(\sinh y)\frac{dy}{dx} = 1$$

$$\frac{dy}{dx} = \frac{1}{\sinh y} = \frac{1}{\sqrt{x^2-1}}$$

$$\cosh^2 y - \sinh^2 y = 1$$

$$\cosh^2 y - 1 = \sinh^2 y$$

$$x^2 - 1 = \sinh^2 y$$

$$\sinh y = \sqrt{x^2-1}$$

$y = \text{ARCTANH}\, x \qquad (\tanh^{-1} x)$

$\tanh y = \tanh(\text{ARCTANH}\, x)$

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

$(\text{sech}^2 y)\frac{dy}{dx} = 1$

$\frac{dy}{dx} = \frac{1}{\text{sech}^2 y} = \frac{1}{1 - x^2}$

$\cosh^2 y - \sinh^2 y = 1$

$\cosh^2 y$

$1 - \tanh^2 y = \text{sech}^2 y$

$1 - x^2 = \text{sech}^2 y$

$y = \text{ARCTAN}\, x \qquad \frac{dy}{dx} = \frac{1}{1 + x^2}$

$y = \text{ARCTANH}\, x \qquad \frac{dy}{dx} = \frac{1}{1 - x^2}$