$$\left[\sin\left(e^{\cos(2e^{3x})}\right)\right]' =$$

$$\left[\cos\left(e^{\cos(2e^{3x})}\right)\right] \cdot e^{\cos(2e^{3x})} \cdot \left(-\sin(2e^{3x}) \cdot 2e^{3x} \cdot 3\right)$$

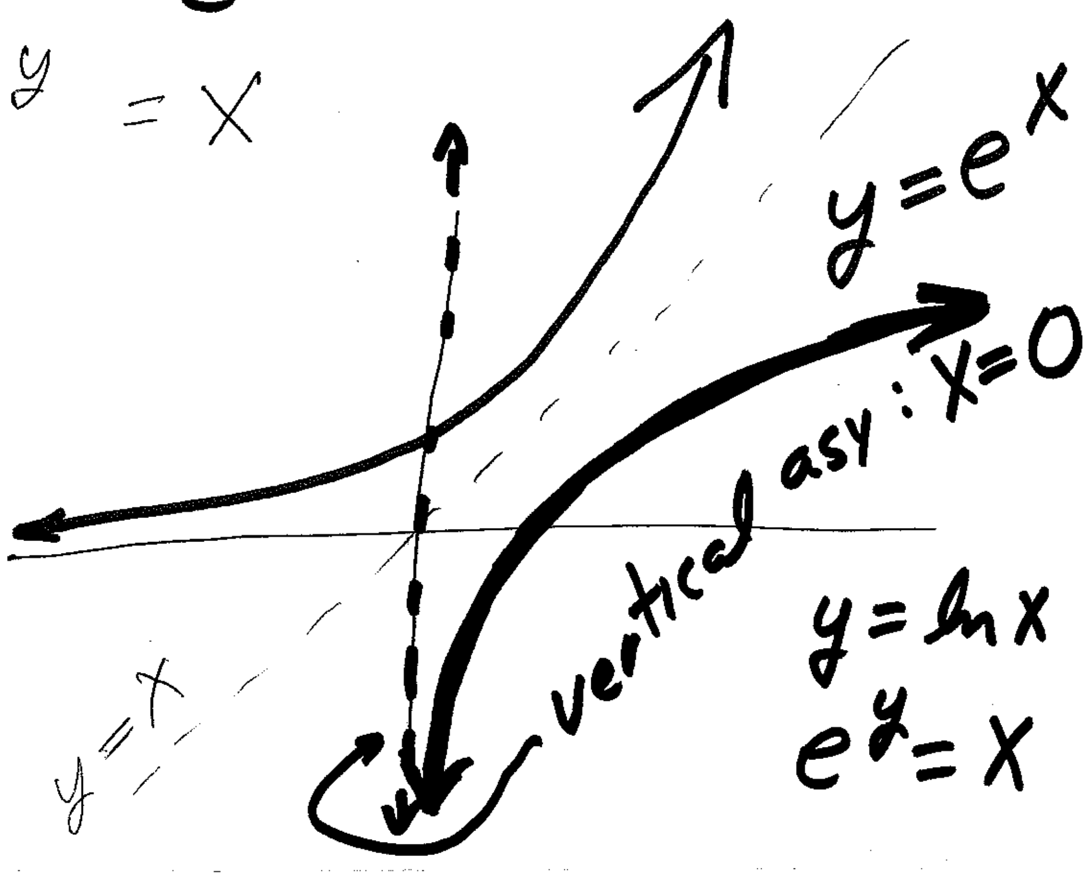
$$= \left[\cos\left(e^{\cos(2e^{3x})}\right)\right] \cdot e^{\cos(2e^{3x})} \cdot \left(-\sin(2e^{3x})\right) \cdot 6e^{3x}$$

$\boxed{4.2}$

$$y = \ln x$$

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

$$e^{y} = x$$



Let $y = \ln x$

Find $\dfrac{dy}{dx} = \dfrac{d(\ln x)}{dx}$

$$y = \ln x$$

Use implicit diff to simplify

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

$$e^y = x$$

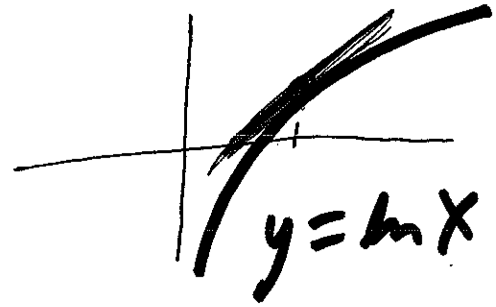
$$\frac{d(e^y)}{dx} = \frac{d(x)}{dx}$$

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

$$x \cdot \frac{dy}{dx} = 1$$

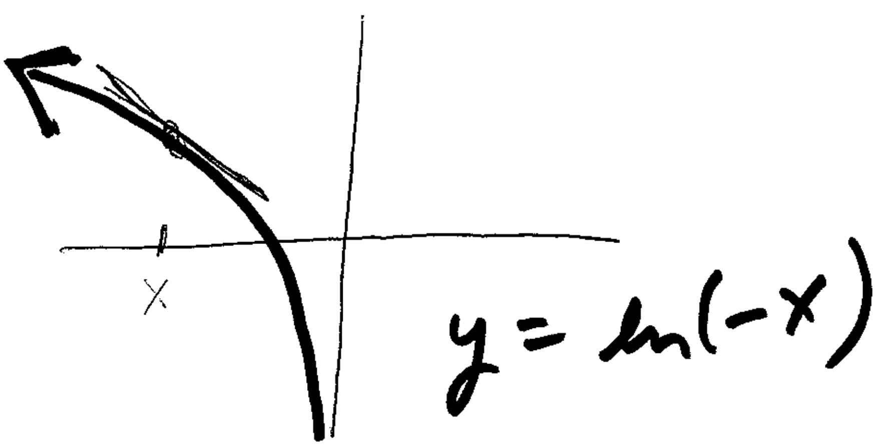
$$\frac{dy}{dx} = \frac{1}{x}$$

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



$$[\ln(-x)]' = \frac{1}{-x} \cdot (-x)'$$

$$= \frac{1}{-x} \cdot (-1) = \frac{1}{x}$$

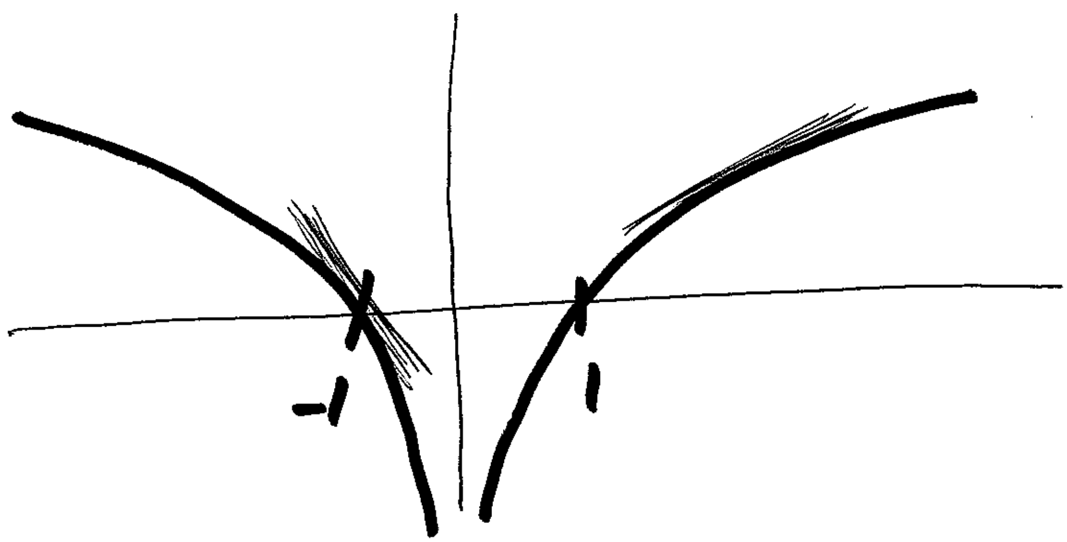


$$[\ln|x|]' =$$

$$|x| = \begin{cases} x & , \text{ if } x \geq 0 \\ -x & , \text{ if } x < 0 \end{cases}$$

$$\ln|x| = \begin{cases} \ln x & \text{if } x > 0 \\ \ln(-x) & \text{if } x < 0 \end{cases}$$

$$[\ln|x|]' = \frac{1}{x} \quad \text{for all } x \neq 0$$



$$\left[\ln|x^5+2x+1|\right]'$$

$$= \frac{1}{x^5+2x+1} \cdot (x^5+2x+1)'$$

$$= \boxed{\frac{5x^4+2}{x^5+2x+1}}$$

$$\left[\ln|f(x)|\right]' = \frac{f'(x)}{f(x)}$$

special case of chain rule

$$\left(\ln\left(e^{3x}\cdot(x+1)\right)\right)'$$

$$=\left[\ln(e^{3x})+\ln(x+1)\right]'$$

$$=\left[3x+\ln(x+1)\right]'$$

$$=\boxed{3+\frac{1}{x+1}}$$

$$\left[\ln(x^2)\cdot\ln(x+1)\right]'$$

$$\left[2\ln x\cdot\ln(x+1)\right]'=2[\quad]'$$

$$2\left[\frac{\ln x}{x+1}+\frac{\ln(x+1)}{x}\right]$$

$$\left[\ln(x^2)\cdot\ln(x+1)\right]'$$

$$\frac{\ln(x^2)}{x+1} + \frac{\ln(x+1)}{x^{\cancel{2}}}\cdot 2\cancel{x}$$

$$= \frac{\ln(x^2)}{x+1} + \frac{2\ln(x+1)}{x}$$

$$\left(\frac{\sin x}{e^x}\right)' = \frac{e^x \cos x - (\sin x) e^x}{e^{2x}}$$

$$= \frac{\cos x - \sin x}{e^x}$$

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

$$\ln y = \ln\left(\frac{\sin x}{e^x}\right)$$

$$= \ln(\sin x) - \ln(e^x)$$