Q1

Monday, October 5, 2020 3:11 PM

Find the derivative.

$f(x) = e^x \cosh(x)$

$f'(x) = e^{x}\left[\sinh(x) + \cosh(x)\right]$

The Product Rule

$$\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}[g(x)] + g(x)\frac{d}{dx}[f(x)]$$

$$f(x) = e^x \cosh(x)$$

$$f'(x) = \frac{d}{dx}\left[e^x \cosh(x)\right]$$

$$= e^x \frac{d}{dx}\left[\cosh(x)\right] + \cosh(x)\frac{d}{dx}\left(e^x\right)$$

$$= e^x \sinh(x) + \cosh(x)\, e^x$$

$$\boxed{f'(x) = e^x\left[\sinh(x) + \cosh(x)\right]}$$

Q2

Monday, October 5, 2020 3:25 PM

Find the derivative.

$g(x) = \sinh^2(x)$

$g'(x) = \boxed{2\sinh(x)\cosh(x)}$

$g(x) = \sinh^2(x)$

$g'(x) = \frac{d}{dx}\left[(\sinh(x))^2\right]$

$= \frac{dy}{du}(u^2)\frac{du}{dx}(u)$

$= 2u\frac{d}{dx}[\sinh(x)]$

$\boxed{g'(x) = 2\sinh(x)\cosh(x)}$

chain Rule

$u = \sinh(x)$

$f(u) = u^2 = y$

$\frac{dy}{du} \cdot \frac{du}{dx}$

Q3

Monday, October 5, 2020 3:31 PM

Find the derivative.

$y = e^{\cosh(3x)}$

$y'(x) = 3\sinh(3x)e^{\cosh(3x)}$

$y = e^{\cosh(3x)}$

$y' = \frac{d}{dx}\left[e^{\cosh(3x)}\right]$

Chain Rule

$u = \cosh(3x)$

$f(u) = e^u = y$

$\frac{dy}{du} \frac{du}{dx}$

$= \frac{dy}{du}(e^u) \frac{du}{dx}(u)$

$= e^{\cosh(3x)} \frac{d}{dx}\left[\cosh(3x)\right]$

Chain Rule

$v = 3x$

$f(v) = \cosh(v) = y$

$\frac{dy}{dv} \cdot \frac{dv}{dx}$

$= e^{\cosh(3x)} \frac{dy}{dv}\left[\cosh(v)\right] \frac{dv}{dx}(v)$

$= e^{\cosh(3x)} \sinh(3x) \frac{d}{dx}(3x)$

$= e^{\cosh(3x)} \sinh(3x)\, 3$

$$\boxed{y' = 3\sinh(3x)e^{\cosh(3x)}}$$

Q4

Monday, October 5, 2020 3:40 PM

Find the derivative.

$f(x) = x \sinh(x) - 4 \cosh(x)$

$f'(x) = x\cosh(x) - 3\sinh(x)$

The Product Rule

$$\frac{d}{dx}[f(x)g(x)] = f(x)\frac{d}{dx}[g(x)] + g(x)\frac{d}{dx}[f(x)]$$

$$f(x) = x\sinh(x) - 4\cosh(x)$$

$$f'(x) = \frac{d}{dx}\left[x\sinh(x) - 4\cosh(x)\right]$$

$$= x\frac{d}{dx}[\sinh(x)] + \sinh(x)\frac{d}{dx}(x) - 4\frac{d}{dx}[\cosh(x)]$$

$$= x\cosh(x) + \sinh(x)(1) - 4\sinh(x)$$

$$\boxed{f'(x) = x\cosh(x) - 3\sinh(x)}$$

Q5

Monday, October 5, 2020 3:50 PM

Find the derivative.

$$g(x) = \cosh(\ln(x))$$

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

$$g(x) = \cosh(\ln(x))$$

$$g'(x) = \frac{d}{dx}\left[\cosh(\ln(x))\right]$$

$$= \frac{dy}{du}\left[\cosh(u)\right]\frac{du}{dx}(u)$$

$$= \sinh(\ln(x))\frac{d}{dx}\left[\ln(x)\right]$$

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

Chain Rule

$u = \ln(x)$

$f(u) = \cosh(u) = y$

$\frac{dy}{du} \cdot \frac{du}{dx}$

Q6

Monday, October 5, 2020 3:58 PM

Find the derivative.

$y = \sinh(\cosh(x))$

$y'(x) = \boxed{\cosh(\cosh(x))\sinh(x)}$

$$y = \sinh(\cosh(x))$$

$$y'(x) = \frac{d}{dx}\left[\sinh(\cosh(x))\right]$$

$$= \frac{dy}{du}\left[\sinh(u)\right]\frac{du}{dx}(u)$$

$$= \cosh(\cosh(x))\frac{d}{dx}(\cosh(x))$$

$$\boxed{y'(x) = \cosh(\cosh(x))\sinh(x)}$$

Chain Rule

$u = \cosh(x)$

$f(u) = \sinh(u) = y$

$\frac{dy}{du} \cdot \frac{du}{dx}$

Q7

Monday, October 5, 2020 4:03 PM

Find the derivative.

$$G(x) = \frac{3 - \cosh(x)}{3 + \cosh(x)}$$

$$G'(x) = \boxed{-\frac{6\sinh(x)}{(\cosh(x)+3)^2}}$$

The Quotient Rule

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)\frac{d}{dx}[f(x)] - f(x)\frac{d}{dx}[g(x)]}{[g(x)]^2}$$

$$G(x) = \frac{3-\cosh(x)}{3+\cosh(x)}$$

$$G'(x) = \frac{(3+\cosh(x))\frac{d}{dx}\left[(3-\cosh(x))\right] - (3-\cosh(x))\frac{d}{dx}\left[(3+\cosh(x)\right]}{(\cosh(x)+3)^2}$$

$$= \frac{(3+\cosh(x))(-\sinh(x)) - (3-\cosh(x))(\sinh(x))}{(\cosh(x)+3)^2}$$

$$= \frac{-3\sinh(x) - \sinh(x)\cosh(x) - [3\sinh(x) - \sinh(x)\cosh(x)]}{(\cosh(x)+3)^2}$$

$$= \frac{-3\sinh(x) \cancel{- \sinh(x)\cosh(x)} - 3\sinh(x) \cancel{+ \sinh(x)\cosh(x)}}{(\cosh(x)+3)^2}$$

$$= \boxed{\frac{-6\sinh(x)}{(\cosh(x)+3)^2}}$$

Q8

Monday, October 5, 2020 5:14 PM

Find the derivative.

$$h(t) = \coth\left(\sqrt{2 + t^2}\right)$$

$$h'(t) = \boxed{\frac{-t\,\operatorname{csch}^2\left(\sqrt{2+t^2}\right)}{\sqrt{2+t^2}}}$$

$$h(t) = \coth\left(\sqrt{2+t^2}\right)$$

$$h'(t) = \frac{d}{dx}\left[\coth\left(\sqrt{2+t^2}\right)\right]$$

Chain Rule

$u = \sqrt{2+t^2}$

$f(u) = \coth(u) = y$

$\frac{dy}{du} \cdot \frac{du}{dx}$

$$= \frac{dy}{du}\left[\coth(u)\right]\frac{du}{dx}(u)$$

$$= -\operatorname{csch}^2\left(\sqrt{2+t^2}\right)\frac{d}{dx}\left(\sqrt{2+t^2}\right)$$

Chain Rule

$v = 2+t^2$

$f(v) = \sqrt{v} = y$

$\frac{dy}{dv} \quad \frac{dv}{dx}$

$$= -\operatorname{csch}^2\left(\sqrt{2+t^2}\right)\frac{dy}{dv}\left(\sqrt{v}\right)\frac{dv}{dx}(v)$$

$$= -\operatorname{csch}^2\left(\sqrt{2+t^2}\right)\frac{dy}{dv}\left(v^{1/2}\right)\frac{d}{dx}\left(2+t^2\right)$$

$$= -\operatorname{csch}^2\left(\sqrt{2+t^2}\right)\left[\frac{1}{2}\left(2+t^2\right)^{-1/2}\right](0+2t)$$

$$= -\operatorname{csch}^2\left(\sqrt{2+t^2}\right)\frac{1}{2}\left(\frac{1}{\sqrt{2+t^2}}\right)(2t)$$

$$= \frac{-2t\operatorname{csch}^2\left(\sqrt{2+t^2}\right)}{2\sqrt{2+t^2}}$$

$$\boxed{h'(t) = -\frac{t\operatorname{csch}^2\left(\sqrt{2+t^2}\right)}{2\sqrt{2+t^2}}}$$