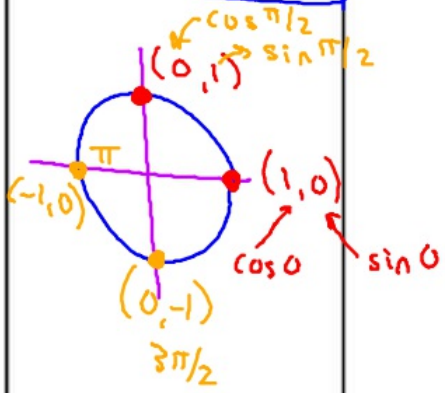
⊥ line

	sin	cos
$\pi/6$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$
$\pi/4$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$
$\pi/3$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$



Find equations for the lines that are tangent and normal to the graph of y = 2cosx at $x = \frac{\pi}{4}$

$\left(\frac{\pi}{4}, \sqrt{2}\right)$ (x_1, y_1)

$\frac{dy}{dx} = -2\sin x$

$y = 2\cos\frac{\pi}{4}$

$y = 2\left(\frac{\sqrt{2}}{2}\right) = \sqrt{2}$

$\left.\frac{dy}{dx}\right|_{x=\frac{\pi}{4}} = -2\sin\frac{\pi}{4} = -2\left(\frac{\sqrt{2}}{2}\right) = -\sqrt{2}$ (m)

Tangent: $y = \sqrt{2} - \sqrt{2}\left(x - \frac{\pi}{4}\right)$

Normal: $y = \sqrt{2} + \frac{1}{\sqrt{2}}\left(x - \frac{\pi}{4}\right)$

Find the points on the curve y = cot x, $0 \le x \le \frac{\pi}{2}$, where the tangent line is parallel to the line y = -2x.

$\frac{dy}{dx} = -2$

$y = \cot x$

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

$-2 = -\csc^2 x$

$2 = \csc^2 x$

$(\sin^2 x)\,2 = \frac{1}{\cancel{\sin^2 x}}\,(\cancel{\sin^2 x})$

$\frac{2\sin^2 x}{2} = \frac{1}{2}$

$\sqrt{\sin^2 x} = \sqrt{\frac{1}{2}}$

$\sin x = \pm\sqrt{\frac{1}{2}}$

$\sin x = \pm\frac{\sqrt{2}}{2}$

$x = \frac{\pi}{4}$

$\sqrt{\frac{1}{2}} = \frac{\sqrt{1}}{\sqrt{2}}$

$\frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{2}$

$\frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$

What you'll Learn About

- How to find the derivative of a composite function

$A)\ \ y = \sin(x)$

$B)\ \ y = \sin(x^2 - 4)$

$C)\ \ y = cos^2(3x)$

$D)\ \ y = (\csc x)^2 \cot x$

	$E)\quad y = 5\sqrt{\sin(2x) + \cos(2x)}$
	$E)\quad y = (\sin x + \cos x)^{-2}$
	$F)\quad y = \dfrac{1}{\left(\sin\left(x^3\right) + \cos\left(x^3\right)\right)^4}$

	$G)\quad y=\dfrac{x^2}{\sqrt{1+x^3}}$
	$G)\quad y=\dfrac{x^2}{\sqrt{1+x^3}}$
	$H)\quad y=\left(5x+\sqrt[3]{x}\right)^4$

	$I)\ \ y = x^4(3x - 6)^5$ $J)\ \ y = \dfrac{1}{(1-2x)^3}$

	$L)\ \ y=\sqrt{3x\csc x}$
	$M)\ \ y=3x\sqrt{\csc x}$
	N) Find y″ if $y=9\cot\left(\frac{x}{3}\right)$

Suppose that functions f and g and their derivatives have the following values at x = 2 and x = 3.

x	f(x)	g(x)		
2	8	2	1/3	-3
3	3	-4	2π	5

Evaluate the derivatives with respect to x

A) $2f(x)$ at $x = 2$

B) $f(x) + g(x)$ at $x = 3$

C) $f(x)g(x)$ at $x = 3$

D) $\frac{f(x)}{g(x)}$ at $x = 2$

	$E)$ $f(g(x))$ at $x=2$ $F)$ $\sqrt{f(x)}$ at $x=2$ $G)$ $\dfrac{1}{g^2(x)}$ at $x=3$ $F)$ $\sqrt{f^2(x)+g^2(x)}$ at $x=2$

What you'll Learn About

- How to find the derivative of inverse functions

Find the derivative of the inverse sine function using implicit differentiation

	$A)\quad y=\arcsin\left(x^2\right)$ $B)\quad y=\arccos\left(\frac{1}{x}\right)$ $C)\quad y=x^2\arccos(\sin x)$ $D)\quad y=x\sqrt{1-x^2}+\arctan\sqrt[3]{x}$ $E)\quad f(x)=arccsc\left(5x^3-\sin x\right)$ Find the equation of the tangent line $F)\quad y=\csc^{-1}x$ at $x=2$

G) Find the derivative of f(x) = sinx at $x = \frac{\pi}{6}$

H) Find the derivative of f(x) = arcsinx at $x = \frac{1}{2}$

1. Let f be a differentiable function such that f(3) = 15, f(6) = 3, $f'(3) = -8$ and $f'(6) = -2$.
   The function g is differentiable and $g(x) = f^{-1}(x)$ for all x. What is the value of $g'(15)$?

a) -1/2 b) -1/8 c) 1/6 d) 1/3

e) The value of $g'(15)$ cannot be determined

2. Let f be a differentiable function such that f(3) = 5, f(8) = 4, $f'(3) = 6$ and $f'(8) = 3$.
The function g is differentiable and $g(x) = f^{-1}(x)$ for all x. What is the value of $g'(4)$?

a) -1/2 b) -1/8 c) 1/6 d) 1/3
e) The value of $g'(4)$ cannot be determined

3. Let f be a differentiable function such that f(3) = 5, f(8) = 4, $f'(3) = 6$ and $f'(8) = 3$.
The function g is differentiable and $g(x) = f^{-1}(x)$ for all x. What is the value of $g'(5)$?

a) -1/2 b) -1/8 c) 1/6 d) 1/3
e) The value of $g'(5)$ cannot be determined

4. If $f(2) = -3$, $f'(2) = \frac{4}{3}$, and $g(x) = f^{-1}(x)$, what is the equation of the tangent line to g(x) at x = -3?

A) $y-2 = \frac{-3}{4}(x+3)$ B) $y+2 = \frac{-3}{4}(x-3)$

C) $y-2 = \frac{3}{4}(x+3)$ D) $y+3 = \frac{3}{4}(x-2)$

E) $y-2 = \frac{4}{3}(x+3)$

5. *If* $f(2) = -3$, $f'(2) = \frac{-4}{3}$, and $g(x) = f^{-1}(x)$,

what is the equation of the tangent line to g(x) at x = -3?

A) $y\text{-}2 = \frac{-3}{4}(x+3)$

B) $y+2 = \frac{-3}{4}(x-3)$

C) $y\text{-}2 = \frac{3}{4}(x+3)$

D) $y+2 = \frac{4}{3}(x-3)$

E) $y\text{-}2 = \frac{4}{3}(x+3)$

6. *If* $f(2) = -3$, $f'(2) = \frac{-3}{4}$, and $g(x) = f^{-1}(x)$,

what is the equation of the tangent line to g(x) at x = -3?

A) $y\text{-}2 = \frac{-3}{4}(x+3)$

B) $y+3 = \frac{-4}{3}(x+2)$

C) $y\text{-}2 = \frac{3}{4}(x+3)$

D) $y+2 = \frac{4}{3}(x-3)$

E) $y\text{-}2 = \frac{-4}{3}(x+3)$

What you'll Learn About
How to take the derivative of exponential and logarithmic functions

A) $y = 5^x$

B) $y = 7^{x^2}$

C) $y = 5^{\sin x}$

D) $y = 6^{\arctan x^3}$

E) $y = e^x$

F) $y = 5e^{5x}$

G) $y = (5e)^{5x}$

H) $y = e^{\frac{-3}{4}x}$

I) $y = x^3 e^{4x} - x^4 e^{2x}$

B) $y = 7^{x^2}$

	$A)\quad y=\log_5\left(x^3\right)$ $B)\quad y=\log_6\sqrt[3]{x}$ $C)\quad y=\log_5\left(\frac{4}{x}\right)$ $D)\quad y=\frac{5}{\log_7\left(x^2\right)}$ $E)\quad y=\ln x$ $F)\quad y=\ln\left(x^4\right)$ $G)\quad y=(\ln x)^4$ $H)\quad y=\ln\left(\frac{5}{x}\right)$ $I)\quad y=x^3 ln\left(x^2\right)-\ln(\ln(\arcsin x))$

What you'll Learn About
How to take the derivative of functions in Parametric Form

Graph the parametric function given

A) $x = t^2 - 3 \quad y = t \quad t \geq 0$

B) Find the derivative of the function at t=5

C) Find the equation of the tangent line at t=1

$x = 3t \quad y = 9t^2$

D) Find the equation of the tangent line at $\theta = \frac{\pi}{4}$

$x = \cos\theta \quad y = \sin\theta$

E) Find the equation of the tangent line at $t = \pi$

$x = \sec^2(2t) - 1 \quad y = t\tan(2t)$

	A curve C is defined by the parametric equations $x = t^2 - 4t + 1$ and $y = t^3$. Determine the equation of the line tangent to the graph of C at the point (1, 64)? Determine the horizontal and vertical tangents for the parametric curve *A*) $x = 1 - t \quad y = t^2 - 4t$ *B*) $x = \cos\theta \quad y = 2\sin(2\theta)$

