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

- 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 \( y = \cot x \), \( 0 \leq x \leq \frac{\pi}{2} \), where the tangent line is parallel to the line \( y = -2x \).

- \( \frac{1}{\sqrt{2}} = \sqrt{\frac{1}{2}} \)
- \( \frac{1}{\sqrt{2}} \cdot \sqrt{\frac{1}{2}} = \frac{\sqrt{2}}{2} \)
- \( \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2} \)
CALCULUS: Graphical, Numerical, Algebraic by Finney, Demana, Watts and Kennedy
Chapter 3: Derivatives 3.6: Chain Rule pg. 148-156

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) \[ y = 5\sqrt{\sin(2x) + \cos(2x)} \]

E) \[ y = (\sin x + \cos x)^2 \]

F) \[ y = \frac{1}{(\sin(x^3) + \cos(x^3))} \]
G) \[ y = \frac{x^2}{\sqrt{1+x^3}} \]

H) \[ y = (5x + \sqrt{x})^4 \]
I) \[ y = x^4(3x - 6)^3 \]

J) \[ y = \frac{1}{(1-2x)^3} \]
L) \( y = \sqrt{3} \tan x \)

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 $x = 3$.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
<th>$g(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>8</td>
<td>2/3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>-4</td>
</tr>
</tbody>
</table>

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) \( \frac{1}{g^2(x)} \) at \( x = 3 \)

F) \( \sqrt{f^2(x) + g^2(x)} \) at \( x = 2 \)
Find the derivative of the inverse sine function using implicit differentiation
A) \[ y = \arcsin(x^2) \]

B) \[ y = \arccos\left(\frac{1}{x}\right) \]

C) \[ y = x^2\arccos(\sin x) \]

D) \[ y = x\sqrt{1-x^2} + \arctan\sqrt{x} \]

E) \[ f(x) = \arccsc(5x^3 - \sin x) \]

Find the equation of the tangent line

F) \[ y = \csc^{-1}x \text{ at } x = 2 \]
G) Find the derivative of \( f(x) = \sin x \) at \( x = \frac{\pi}{6} \).

H) Find the derivative of \( f(x) = \arcsin x \) 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 \( g(x) = f'(x) \) for all \( x \). What is the value of \( g'(15) \)?

   a) \(-\frac{1}{2}\)   b) \(-\frac{1}{8}\)   c) \(\frac{1}{6}\)   d) \(\frac{1}{3}\)

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

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) \( y - 2 = \frac{3}{4}(x + 3) \)  
B) \( y + 3 = -\frac{4}{3}(x + 2) \)  
C) \( y - 2 = \frac{3}{4}(x + 3) \)  
D) \( y + 2 = \frac{4}{3}(x - 3) \)  
E) \( y - 2 = -\frac{4}{3}(x + 3) \)
<table>
<thead>
<tr>
<th></th>
<th>( A) \quad y = 5^x )</th>
<th>( B) \quad y = 7^x^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( C) \quad y = 5^{\sin x} )</td>
<td>( D) \quad y = 6^{\sec x} )</td>
</tr>
<tr>
<td></td>
<td>( E) \quad y = e^x )</td>
<td>( F) \quad y = 5e^{5x} )</td>
</tr>
<tr>
<td></td>
<td>( G) \quad y = (5e)^x )</td>
<td>( H) \quad y = e^{\frac{3}{x^3}} )</td>
</tr>
<tr>
<td></td>
<td>( I) \quad y = x^{3}e^{4x} - x^4e^{2x} )</td>
<td>( J) \quad y = 7^x^2 )</td>
</tr>
</tbody>
</table>
A) \( y = \log_2 \left( x^3 \right) \)

B) \( y = \log_6 \sqrt[3]{x} \)

C) \( y = \log_2 \left( \frac{4}{x} \right) \)

D) \( y = \frac{5}{\log_7 \left( x^2 \right)} \)

E) \( y = \ln x \)

F) \( y = \ln \left( x^4 \right) \)

G) \( y = \left( \ln x \right)^4 \)

H) \( y = \ln \left( \frac{5}{x} \right) \)

I) \( y = x^3 \ln \left( x^2 \right) - \ln \left( \ln(\arcsinx) \right) \)
What you’ll Learn About
How to take the derivative of functions in Parametric Form

Graph the parametric function given
A) \( x = t^3 - 3 \quad y = t \quad t \geq 0 \)

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

$A) \quad x = 1 - t \quad y = t^2 - 4t$

$B) \quad x = \cos \theta \quad y = 2 \sin(2\theta)$