1 Differentiate.

\[ g(x) = x^{10} \sin x \]

2 Find an equation of the tangent line to the curve \( y = 5 \tan x \) at the point \( \left( \frac{\pi}{4} , 5 \right) \).

\[ a. \quad y = 16x + 6 \left( 1 - \frac{\pi}{2} \right) \\
   b. \quad y = 5x + 13 \left( 1 - \frac{\pi}{2} \right) \\
   c. \quad y = 2x + 15 \left( 1 - \frac{\pi}{2} \right) \\
   d. \quad y = 12x + 12 \left( 1 - \frac{\pi}{2} \right) \\
   e. \quad y = 10x + 5 \left( 1 - \frac{\pi}{2} \right) \\
   f. \quad y = 19x + 9 \left( 1 - \frac{\pi}{2} \right) \]

3 A ladder 8 feet long rests against a vertical wall. Let \( \theta \) be the angle between the top of the ladder and the wall and let \( x \) be the distance from the bottom of the ladder to the wall. If the bottom of the ladder slides away from the wall, how fast does \( x \) change with respect to \( \theta \) when \( \theta = \pi/3 \)?

\[ a. \quad 4 \text{ ft/rad} \\
   b. \quad 6.5 \text{ ft/rad} \\
   c. \quad 2.5 \text{ ft/rad} \\
   d. \quad 6 \text{ ft/rad} \\
   e. \quad 7 \text{ ft/rad} \\
   f. \quad 3 \text{ ft/rad} \]

4 Find the limit.

\[ \lim_{\theta \to 0} \frac{\sin^7 \theta}{(3\theta)^4} \]
5 A mass on a spring vibrates horizontally on a smooth level surface (see the figure). Its equation of motion is \( x(t) = 6\sin t \), where \( t \) is in seconds and \( x \) in centimeters. Find the velocity at time \( t \).

\[ \begin{align*}
\text{equilibrium position} \\
0 & \quad x
\end{align*} \]

- a. \( v(t) = 6\cos t \)
- b. \( v(t) = \cos 6t \)
- c. \( v(t) = 6\sin 6t \)
- d. \( v(t) = \sin 6t \)

6 Find the limit.

\[
\lim_{x \to \pi / 4} \frac{\sin x + \cos x}{\cos 2x}
\]

- a. \( \infty \)
- b. \(- \infty \)
- c. \( -\frac{\sqrt{2}}{2} \)
- d. \( \frac{\sqrt{2}}{2} \)

7 If \( f \) is a differentiable function, find an expression for the derivative of the following function.

\[
y = \frac{7 + x^9 f(x)}{\sqrt{x}}
\]
A semicircle with diameter sits on an isosceles triangle to form a region shaped like an ice cream cone, as shown in the figure. If \( A(\theta) \) is the area of the semicircle and \( B(\theta) \) is the area of the triangle, find

\[
\lim_{\theta \to \pi/2} \frac{A(\theta)}{B(\theta)}
\]

a. \( \frac{\pi}{2} \)
b. \( \frac{\sqrt{3}\pi}{2} \)
c. \( \frac{\sqrt{3}\pi}{6} \)
d. 0
10x^9 \sin(x) + x^{10} \cos(x)

\begin{align*}
g'(x) &= 10x^9 \sin(x) + x^{10} \cos(x) \\
\frac{d}{dx} g &= x^{10} \cos(x) + 10x^9 \sin(x)
\end{align*}

2. e
3. a
4. 0
5. a
6. a

y' = \frac{17x^9 f(x) + 2x^{10} f'(x) - 7}{2x^2}

y'(x) = \frac{17x^9 f(x) + 2x^{10} f'(x) - 7}{2x^2} \left( \frac{3}{\frac{3}{2}} \right) \left( \frac{2x^2}{2x^2} \right)

\begin{align*}
y'(x) &= \frac{17x^9 f(x) + 2x^{10} f'(x) - 7}{2x^2} \left( \frac{3}{\frac{3}{2}} \right) \\
y' &= \frac{17x^9 f + 2x^{10} f' - 7}{2x^2}
\end{align*}

7.

y'(x) = \frac{17x^9 f + 2x^{10} f' - 7}{2x^2}

y' = \frac{17x^9 f + 2x^{10} f' - 7}{2x^2}

8. a