1. Find the derivative

\[ f(x) = 2^{\cos x} \]

\[ f'(x) = \ln 2 \cdot 2^{\cos x} (-\sin x) \]
2. Find the derivative

\[ g(x) = \log_5(\sqrt[3]{x}) \]

\[ g(x) = \log_5(x^{\frac{1}{3}}) \]

\[ g(x) = \frac{1}{3} \log_5 x \]

\[ g'(x) = \frac{1}{3 \ln 5 \cdot x^{\frac{1}{3}}} \]
3. Let $f$ be the function defined by $f(x) = x^4 - 2x + 3$. If $g(x) = f^{-1}(x)$ and $g(5) = 1$, what is the value of $g'(5)$?

$$g'(5) = \frac{1}{f'(g(5))} = \frac{1}{f'(1)} = \frac{1}{4(1)^3 - 2} = \frac{1}{2}$$
4. Write an equation to the line tangent to the curve \( y = \arctan(4x) \) at the point at which \( x = \frac{1}{4} \).

\[
y - \frac{\pi}{4} = 2 \left( x - \frac{1}{4} \right)
\]
5. Let \( f \) be a differentiable function such that \( f(-1) = 7 \), \( f'(9) = -1 \), \( f'(-1) = -4 \), and \( f'(-1) = -5 \). The functions \( g \) and \( f \) are differentiable and inverses for all \( x \). What is the value of \( g'(7) \)?
6. What are the coordinates of the inflection point on the graph of 
\( y = (x + 1) \arctan x \)?

a. \((-1, 0)\)
b. \((0, 0)\)
c. \((0, 1)\)
d. \(\left(1, \frac{\pi}{4}\right)\)
e. \(\left(1, \frac{\pi}{2}\right)\)
7. Find the derivative

\[ y = \log_{10}(4^{-x} + 5^{2x}) \]

\[ y' = \frac{-\ln 4 \cdot 4^{-x} + \ln 5 \cdot 5^{2x} \cdot 2}{\ln 10 \left(4^{-x} + 5^{2x}\right)} \]
8. Find the derivative

\[ \log_5 \sqrt{x^2 - 1} \]
9. Find the derivative

$$25 \arcsin \frac{x}{5} - \arctan \frac{x}{5}$$
10. Find the derivative

$$y = x^3 \arcsin 7x$$
11. Let \( f = 2 \cos x + 1 \). What is the approximation for \( f(1.5) \) found by using the line tangent to the graph of \( f \) at \( x = \frac{\pi}{2} \)? \leave your answer in terms of \( \pi \)

\[
\begin{align*}
f(\frac{\pi}{2}) &= 1, \\
f'(x) &= -2 \sin x, \\
f'(\frac{\pi}{2}) &= -2
\end{align*}
\]

\[
y - 1 = -2(x - \frac{\pi}{2}) \\
y = 1 - 2(1.5 - \frac{\pi}{2})
\]
12. If $f(x) = \ln x$, then $\lim_{x \to 3} \frac{f(x) - f(3)}{x - 3}$ is
13. \( \lim_{{x \to \infty}} \frac{\ln(e^{3x} + x)}{x} = \)
14. When \( x = 2e \), \( \lim_{h \to 0} \frac{\ln(x+h) - \ln(x)}{h} \) is
15. Let \( f \) be the function defined by 
\[ f(x) = \sqrt[3]{x}. \]
What is the approximation for \( f(10) \) found by using the line tangent to the graph of \( f \) at the point \((8, 2)\)?
16. \[ \lim_{{x \to 0}} \frac{4x^2}{e^{4x} - 4x - 1} \] is
17. Selected values of the increasing function $h$ and its derivative $h'$ are shown in the table. If $g$ is a differentiable function such that $h(g(x)) = x$ for all $x$, what is the value of $g'(7)$?

<table>
<thead>
<tr>
<th>$x$</th>
<th>3</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h(x)$</td>
<td>7</td>
<td>22</td>
</tr>
<tr>
<td>$h'(x)$</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
18. Find the slope of the curve at $x = 2$

$$y = 9x^2 - 4$$