1. (2 points each) Using Leibniz notation (i.e., $\frac{dy}{dx}$, $\frac{dP}{dt}$, etc.), find derivatives for each of the following functions.

(a) $w = 2r^5 - \frac{5}{r^3}$

$w = 2r^5 - 5r^{-3}$

$\frac{dw}{dr} = 2 \cdot 5r^4 - 5 \cdot -3r^{-4}$

$\frac{dw}{dr} = 10r^4 + 15r^{-4}$

(b) $q = 5^t + e^\pi$

$\frac{dq}{dt} = \ln 5 \cdot 5^t$ (since $e^\pi$ is a constant its derivative is 0)

2. (2 points) Given that $\frac{d}{dx} \left( \tan^{-1} x \right) = \frac{1}{1 + x^2}$ find the derivative of the following function.

$g(x) = 5x^3 \tan^{-1} x$

$g'(x) = (5x^3)' \left( \tan^{-1} x \right) + \left( 5x^3 \right)' \left( \tan^{-1} x \right)'$

$g'(x) = (15x^2) \left( \tan^{-1} x \right) + \left( 5x^3 \right) \left( \frac{1}{1 + x^2} \right)$

$g'(x) = 15x^2 \tan^{-1} x + \frac{5x^3}{1 + x^2}$
3. (2 points) Find the \( x \)-value for each point on the graph of \( f(x) = 2x^3 + 9x^2 - 60x + 40 \) where the tangent line to the curve is horizontal.

\[
f'(x) = 6x^2 + 18x - 60
\]

A horizontal line has slope 0 so we set \( f'(x) = 0 \) to obtain

\[
6x^2 + 18x - 60 = 0
\]
\[
6(x^2 + 3x - 10) = 0
\]
\[
6(x + 5)(x - 2) = 0
\]
\[
x = -5 \text{ or } x = 2
\]

Thus there is one horizontal tangent line at \( x = -5 \) and a second one at \( x = 2 \).

4. (2 points) Find the derivative of the following function.

\[
y = \frac{\sqrt[3]{x} + x^{-2}}{\sqrt{x}}
\]
\[
y = \frac{\sqrt[3]{x}}{\sqrt{x}} + \frac{x^{-2}}{\sqrt{x}}
\]
\[
y = \frac{x^{1/3}}{x^{1/2}} + \frac{x^{-2}}{x^{1/2}}
\]
\[
y = x^{1/3-1/2} + x^{-2-1/2}
\]
\[
y = x^{-1/6} + x^{-5/2}
\]
\[
y' = -\frac{1}{6}x^{-7/6} - \frac{5}{2}x^{-7/2}
\]