1. (4 points) Find the x-value(s) at which the tangent line of the curve \( y = \frac{x^3}{3} - x + 5 \) is parallel to the line \( y = 3x \).

Two lines are parallel when their slopes are equal! So, we want our tangent line to have slope 3.

\[
y' = 3\left(\frac{x^2}{3}\right) - 1 = x^2 - 1.
\]

So, slope is equal to 3 when \( y' = 3 \).

\[
\rightarrow x^2 - 1 = 3
\]

\[
\rightarrow x^2 - 4 = 0
\]

\[
\rightarrow (x + 2)(x - 2) = 0
\]

\[
\rightarrow x = 2, -2
\]
2. (2 points each) Using Leibniz notation (i.e., $\frac{dy}{dx}$, $\frac{dp}{dq}$, etc.), find derivatives for each of the following functions.

(a) $w = (4 + r^2)(e^r - 3)$

$$\frac{dw}{dr} = (4 + r^2)(e^r) + (e^r - 3)(2r).$$

OR

$$w = (4 + r^2)(e^r - 3) = 4e^r - 12 + r^2e^r - 3r^2,$$

so,

$$\frac{dw}{dr} = 4e^r + [r^2e^r + e^r(2r)] - 6r.$$

(b) $f = 4e^t - \frac{1}{\sqrt{t}} + \ln 3 = 4e^t - t^{-1/2} + \ln 3$ constant.

$$\frac{df}{dt} = 4e^t + \frac{1}{2}t^{-3/2}.$$

(c) $y = \frac{2x^2 + x - 1}{x + 1}$

$$\frac{dy}{dx} = \frac{(x + 1)(4x + 1) - (2x^2 + x - 1)(1)}{(x + 1)^2}.$$ 

OR

$$y = \frac{2x^2 + x - 1}{x + 1} = \frac{(2x - 1)(x + 1)}{(x + 1)} = 2x - 1,$$

so,

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