Show all your work.

1. (10 pts. ea.) Find \( \frac{dy}{dx} \) for each of the following:

   (a) \( y = xe^x + 3\sqrt{x} \)

   (b) \( \sec x^2 + \tan^2 x \)

   (c) \( y = \frac{x \cos 3x}{x + 1} \)

   (d) \( y = x^{4x} \)
2. (10 pts.) Find the tangent slope at the point (3, 2) on the curve

\[ \frac{4x}{y} + xy = 12 \]

3. (10 pts.) Where on \( y = \ln \left( \frac{x + 1}{x} \right) \) is \( y' = -\frac{1}{2} \)?
4. (10 pts.) An object moves up and down so that its height (in feet) after $t$ seconds is given by

$$h(t) = 2 + 0.5 \sin(\pi t - \pi)$$

Find a time in $[0,1]$ when its velocity is 0, and then compute the acceleration at that time.

5. (10 pts.) Suppose that $f$ is an abstract function of $x$. If $y = xf^2$, find $y''$. 
6. (10 pts.) The parabola $y = x^2$ (graphed at right) has two tangent lines that pass through the point $(-1, -1)$. Find the $x$-coordinates of the points of tangency.
7. (10 pts.) Suppose that $f(x)$ is the function graphed at right, and that the tangent line at $(3, 2)$ passes through $(0, -2)$. If $y = xf(x^2)$, find the exact value of $y'$ at the point $x = \sqrt{3}$.