Show all your work

1. Compute $y'$ for each of the following.
   
   (a) $y = x^3 + 4x^2 - \sqrt{x} + \frac{2}{x}$
   
   (b) $y = e^{2x} \cos x^2$
   
   (c) $y = \frac{\ln(x + 1)}{x^2 + 2}$
   
   (d) $y = (\sin x)^x$

2. Find $y''$ for $y = \tan(2x)$.

3. Find the equation of the tangent line to the curve $x^3y + xy^3 = 10$ at the point $(1, 2)$.

4. Find all values of $x$ in the interval $[0, 2\pi]$ at which the tangent to
   
   $y = \sin^2 x + \sin x + x$
   
   has slope 1.

5. Suppose that $F(x) = x^2g(2x)$. If $g(6) = 4$ and $g'(6) = -1$, compute $F'(3)$.

6. Suppose that $f(t) = at^2 + bt$. If $f'(0) = 3$ and $f''(0) = 4$, what are $a$ and $b$?

7. Suppose that a particle is moving on the curve $x^2 + 3y^2 = 28$ with its $x$-coordinate increasing at a rate of 2 cm/s. How fast is the distance between the particle and the origin changing when the particle passes through the point $(1, 3)$?