Name

There are 5 questions, for a total of 100 points. Point values are written beside each question. Calculators may be used only for basic arithmetic operations. *Show your work for full credit.*

1. (a) [5] State the definition of *derivative*, that is \( f'(x) = \)

(b) [15] If \( f(x) = x^2 + 2x \), find \( f'(x) \) using the definition of derivative.
2. Differentiate the following functions.

(a) \( f(x) = \frac{\sqrt{x}}{1 - x^2} \)

(b) \( f(x) = \sec^3(2x + 1) \)
3. [20] Find an equation of the line tangent to the curve \( y^2 - x^2y = \cos(x) \) at the point \( \left( \frac{x}{2}, 0 \right) \).
4. The position of a particle in the plane is \( \mathbf{r}(t) = (\cos(2t), t^2 - 1) \) at time \( t \).

(a) [12] Find the velocity of the particle at time \( t = \frac{\pi}{4} \).

(b) [8] Find the speed of the particle at time \( t = \frac{\pi}{4} \).
5. [20] A video camera is placed 1500 m from the base of a rocket launching pad. A rocket rises vertically and its speed is 300 m/s when it has risen 2000 m. If the video camera is always kept focused on the rocket, how fast is the camera's angle of elevation changing at that moment?