(1) (10 points each) Differentiate the function.

(a) \[ f(x) = \frac{3}{\sqrt{x}} - 4 \sin 5x + e^{-6x} + \sec^{-1} x + 8 \ln 9x. \]

(b) \[ f(x) = e^{x^2} \tan(x^3). \]

(c) \[ f(x) = \frac{7x + \cos 8x}{2 + 3 \ln x}. \]

(2) (10 points) Find \( f''(x) \) for the function \( f(x) = \tan 5x \).
(3) (10 points each) Differentiate the function.

(a) \( f(x) = \ln \left( \frac{\sqrt{x} + 6e^{3x+1}}{(9x+7)^8} \right) \).

(b) \( f(x) = x^{\sin x} \).

(c) \( \lim_{x \to 0} \frac{x \cos x}{\sin 2x} \).

(d) \( \lim_{x \to \infty} \frac{9 + \sin x}{x^2} \).
(4) (10 points) This is the graph of the position function of an object moving along a number line.

(a) For which $t$ values is the object moving to the right?
(b) For which $t$ values is the object moving to the left?
(c) For which $t$ values is the object standing still?
(d) For which $t$ values is the velocity not defined?
(e) Sketch the graph of the velocity function, where defined.
(5) (10 points) Do the following for this equation
\[ x^2 + xy^2 = 4x - 2y \]
(a) Use implicit differentiation to find \( y' \).
(b) Find the equation of the tangent line at the point where \( x = 1 \) and \( y = 1 \).
(6) (10 points) A ladder of length 25 ft is leaning against a wall when the foot of the ladder begins to slide away at the rate of 3 ft/sec. How fast is the top of the ladder dropping, at the instant when the foot of the ladder is 20 ft from the wall?