(1) (5 points each) Differentiate the following functions.

(a) \( f(x) = \frac{4}{\sqrt{x}} + \ln(x^2) \)

(b) \( f(x) = \sin(3x^2 + 4) \)

(c) \( f(x) = \sin^{-1}(x^2) \)

(d) \( f(x) = e^{1-x} \tan 4x \)
(2) (5 points each) Differentiate the following functions.
(a) \( f(x) = \sqrt{\cos 2x} \)

(b) \( f(x) = \frac{\ln(2x + 1)}{3x^2 + 4x + 5} \)

(3) (10 points) Differentiate the following function.
\[ y = x^{\sin x} \]
(4) (15 pts.) An object is moving along a line. Its position at time $t$ is given by the equation of motion $s(t) = t^2(t - 1)$, $t \geq 0$, where $s$ is in feet and $t$ is in seconds. Find

(a) The average velocity for the first two seconds.
(b) The velocity function.
(c) The acceleration function.
(d) When is it at rest?
(e) The total distance traveled during the time interval $0 \leq t \leq 2$.
(f) Sketch the graph of $s(t)$ for the time interval $0 \leq t \leq 2$. 
(5) (15 pts.) Use implicit differentiation to find \( y' \). Find the equation of the tangent line to the curve at the point \((\pi/2, \pi)\).

\[ y \cos x = x \sin y \]
(6) (15 pts.) One early morning in June on a long straight deserted highway two eighteen-wheelers approach each other. Truck A driving north at 70 MPH passes mile marker 100 at the same instant that truck B driving south at 80 MPH passes mile marker 102. Assume their lanes are 0.5 mile apart. How fast is the distance separating A and B changing?
(7) (15 pts.) Let $f$ be the piecewise-defined function

$$f(x) = \begin{cases} 
e^{-x} & \text{if } x < 0 \\ 1 - x & \text{if } x \geq 0 \end{cases}$$

(a) State the domain of $f$.
(b) State the set of $x$ values on which $f$ is continuous.
(c) State the set of $x$ values on which $f$ is differentiable.
(d) Write $f'(x)$ as a piecewise-defined function.
(e) Sketch the graph of $f(x)$.
(f) Sketch the graph of $f'(x)$. 