Instructions: Show all work on this test paper. No graphing calculator is allowed.

(1) (10 pts. each) Differentiate the following functions.

(a) \( f(x) = 5x^2 + \frac{1}{x} - \sqrt{x} \)

(b) \( f(x) = 3\sin x + \cos x + 2e^{5x} + \ln x \)

(c) \( f(x) = \frac{2x}{x^4 + 10} \)

(d) \( f(x) = x \tan^{-1} x \)

(e) \( f(x) = \ln \sqrt{\frac{x^2 + 1}{x^3 + 1}} \)
(2) (10 pts.) Differentiate the function \( y = x^{\sqrt{x}} \).

(3) (10 pts.) Find the first and second derivatives of \( f(x) = e^{-x} \sin x \).

(4) (10 pts.) Find the equation of the tangent line to the graph of \( ye^x + xe^y = 1 \) at the point where \( x = 0 \). The number \( e \) may appear in the answer.
(5) (20 pts.) An object is moving along a line. The position at time \( t \) is given by the equation of motion \( s(t) = \frac{t^3}{3} - 3t^2 + 8t, \ 0 \leq t \leq 6. \)

(a) Find the velocity function.
(b) Find the acceleration function.
(c) Give the time intervals for which the object is moving in the positive direction.
(d) Find the total distance traveled during the time interval \([0, 6]\).
(e) Find the average velocity on the time interval \([0, 6]\).
(f) Sketch the graph of \( y = s(t) \) on the time interval \([0, 6]\).