Directions: Do all problems. Show your work and justify your answers. This is a closed book examination, and calculators are not allowed. You are allowed one prepared sheet of material. Make sure your name is on all four pages of your examination.

1 (50) For each of the following functions \( f(x) \), calculate the derivative \( f'(x) \).

   a. \( f(x) = \pi^3 + 2x + x^5 \)

   b. \( f(x) = \sin x + 3\cos 5x \)

   c. \( f(x) = \frac{x^5 + 4x^3 + 7}{x^2 + 1} \)
1 (continued) For each of the following functions $f(x)$, calculate the derivative $f'(x)$.

d. $f(x) = 7x^3 \tan x$

e. $f(x) = \sec \sqrt{x}$

2. (10) Let $f$ be the function defined as follows:

If $x > 0$, then $f(x) = x^2$;
if $-1 \leq x \leq 0$, then $f(x) = -x$;
if $x < -1$, then $f(x) = x$.

For what values of $x$ does $f$ fail to be differentiable at $x$? Why?
3. (20) Consider the curve C given by the equation $x^2 + y^3 - x^2y = 7$.

a. Find $\frac{dy}{dx}$ at the point on C where $(x, y) = (-1, 2)$.

b. Find an equation for the line tangent to the curve C at the point where $(x, y) = (-1, 2)$. 
4 (20) A 30 foot high vertical flagpole stands at the end of a dock. A surfboard is drifting away from that end of the dock at the rate of 3 feet per second. The end of the board nearest the dock is attached to a rope that passes over a pulley at the top of the flagpole. How fast is the rope passing over the pulley when the board is 40 feet from the end of the dock?