PRINT YOUR NAME ___________________________
SIGNATURE ________________________________
SOCIAL SECURITY NUMBER ____________________
INSTRUCTOR ________________________________
LECTURE TIME ______________________________

READ THIS BEFORE YOU BEGIN

This examination contains 8 problems for a total of 200 points. There are 8 pages in this booklet. It is your responsibility to make sure that they are all present. Your solutions must be written legibly and contain all the necessary steps which enabled you to arrive at your answer in order to receive full credit. Unsupported answers will receive little credit. Do not write in the area below.

1. (40 pts.) __________
2. (40 pts.) __________
3. (10 pts.) __________
4. (10 pts.) __________
5. (10 pts.) __________
6. (30 pts.) __________
7. (20 pts.) __________
8. (40 pts.) __________

TOTAL _______
1. (40 pts) Evaluate each of the following limits if it exists. If it does not exist explain why.

(a) \( \lim_{x \to 2} \frac{x^2 + x - 6}{x - 2} \).

(b) \( \lim_{h \to 0} \frac{\sqrt{3+h} - \sqrt{3}}{h} \).

(c) \( \lim_{x \to 0} \frac{\sin^2 3x}{4x^2} \).
2. (40 pts) Find the derivatives of each of the following functions. You need not simplify your answer.

(a) \( f(x) = (7x^4 + x + 17)^9 \).

(b) \( f(x) = \frac{1 + \sin x}{x - \cos x} \).
(c) \( f(x) = x \ln x. \)

(d) \( f(x) = \tan^2(x^3 + 1). \)

3. (10 pts) Let \( F(x) = \int_0^{x^2} e^{\sqrt{t}} \, dt. \) Find \( F'(x). \)
4. (10 pts) Let \( f(x) = \frac{1-x}{1+x} \). Find \( f''(x) \).

5. (10 pts) If \( xy^2 + y\sin(\pi x) = 2 \) find the equation of the tangent line to the curve at \((2,1)\).
6. (30 pts) Carefully sketch and label the graph of the function \( f(x) = x^4 - 4x^3 + 10 \) by using the information obtained in answering the following problems.

(a) Find the intervals where \( f \) is increasing and decreasing and the location of all local extreme values of \( f \).

(b) Find the intervals where \( f \) is concave up and concave down and find all inflection points of \( f \).

(c) Use the information in parts (a) and (b) [NOT YOUR CALCULATOR] to sketch and label the graph of \( f \). If your graph does not match the information in parts (a) and (b) you will not receive any credit for this part.
7. (20 pts) A box with a square base and open top must have a volume of 32,000 cubic centimeters. Find the dimensions of the box that minimize the amount of material required to build it.

8. (40 pts) Find the following:

(a) \( \int (x^2 + 1)^2 \, dx. \)
(b) \[ \int_{0}^{\pi/2} \sin x (1 + \cos x)^5 \, dx. \]

(c) \[ \int \frac{x + 1}{x^2 + 2x + 3} \, dx. \]

(d) \[ \int_{0}^{2} e^{4x} \, dx. \]