MATH 161 - Calculus IA
MIDTERM EXAM 2
November 16, 2006

NAME: ____________________________________________

U.R. ID Number: ____________________________________________

Circle your instructor’s name and lecture time.

Shannon Starr  TuTh 2:00 - 3:15 PM
Sema Salur     MWF 9:00 - 9:50 AM
Aaron Heap     MWF 10:00 - 10:50 AM
Vijay Sookdeo  MWF 10:00 - 10:50 AM

• No calculators, notes, or books are allowed on this exam.

• Please show all your work and justify your answers. You may not receive full credit for a correct answer if insufficient work is shown or insufficient justification is given.

• Clearly label and circle your final answers.

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1. **(20 points)** Differentiate the following functions. You do not need to simplify your answers.

(a) \( f(x) = (3x^2 + 2)^2(8x + 1) \)

(b) \( g(x) = \frac{\sqrt{x} - 1}{\sqrt{x} + 1} \)

(c) \( h(x) = x^2 e^{2x} \)
(d) \( k(x) = \sin x - \arctan x \)

(d) \( l(x) = \frac{\ln x}{x^2 + 1} \)
2. (10 points) A curve $C$ is described by the equation $x^2 + 2xy - y^2 + x = 2.$

(a) Find $\frac{dy}{dx}$.

(b) Find the equation of the tangent line to $C$ at $(1, 2)$. 


3. (20 points) Differentiate the following functions. You do not need to simplify your answers.

(a) \( f(x) = \frac{1 - e^x}{1 + e^x} \)

(b) \( g(x) = \arcsin(1 - x^2) \)
(c) \[ h(x) = \ln(\sec x) \]

(d) \[ k(x) = (2x^6 + 5)^8 \]
4a. (5 points) Without using L’Hospital’s rule, evaluate the following limit.

$$\lim_{x \to 0} \frac{\sin 6x}{4x}$$

4b. (5 points) Evaluate $f^{(286)}(x)$ of $f(x) = \sin x$. 
4c. (5 points)  Find the linearization of \( f(x) = \cos x \) at \( a = \pi/2 \).

5. (15 points)  Use logarithmic differentiation to calculate the derivatives of the following functions.

(a) \( f(x) = (\ln x)^{\cos x} \)
(b) $g(x) = x^e$

(c) $h(x) = \sqrt{3x + 5} \cdot (2x^2 + 3)^{\frac{3}{2}}$
6. **(10 points)** Two cars start moving from the same point. Prof. Sookdeo, in his new Ferarri, travels south at 60 mi/h while Prof. Heap, in his used Pinto, travels west at 25 mi/h. How fast is the distance between the cars increasing two hours later. (Hint: $120^2 + 50^2 = 130^2$)
7. (10 points) A snowball is rolling down a hill and getting bigger. As it picks up snow, the volume of the snowball increases at a rate of 1 cubic-foot per second, that is $1 \text{ ft}^3/\text{sec}$. Assuming that the snowball is perfectly round, calculate the rate the radius is increasing at the moment when the volume is $\frac{4}{3} \pi \text{ ft}^3$. 