I. Multiple choice

A. (5 pts) (no partial credit) Compute $\frac{d}{dx}[\sin^2(xy)]$. Circle one of the following answers:

(a) $2[\sin(xy)][\cos(xy)][y + xy']$

(b) $[\cos^2(xy)][y + xy']$

(c) $2[\sin(xy)][y + xy']$

(d) $2[\sin(xy)][\cos(y + xy')]$

(e) NONE OF THE ABOVE

B. (5 pts) (no partial credit) Find the logarithmic derivative of $(2 + \sin(2x))^\cos x$ w.r.t. $x$. Circle one of the following answers:

(a) $(\cos x)(\ln(2 + \sin(2x))) + (\sin x)\left(\frac{2\cos(2x)}{2 + \sin(2x)}\right)$

(b) $(-\sin x)(\ln(2 + \sin(2x))) + (\cos x)\left(\frac{2\cos(2x)}{2 + \sin(2x)}\right)$

(c) $(\cos x)(\ln(2 + \sin(2x)))$

(d) $(-\sin x)\left(\frac{2\cos(2x)}{2 + \sin(2x)}\right)$

(e) NONE OF THE ABOVE

C. (5 pts) (no partial credit) Find the derivative of $(2 + \sin(2x))^\cos x$ w.r.t. $x$. Circle one of the following answers:

(a) $[(2 + \sin(2x))^\cos x]\left[(\cos x)(\ln(2 + \sin(2x))) + (\sin x)\left(\frac{2\cos(2x)}{2 + \sin(2x)}\right)\right]$?

(b) $[(2 + \sin(2x))^\cos x]\left[(-\sin x)(\ln(2 + \sin(2x))) + (\cos x)\left(\frac{2\cos(2x)}{2 + \sin(2x)}\right)\right]$?

(c) $[(2 + \sin(2x))^\cos x][\cos x(\ln(2 + \sin(2x)))]$?

(d) $[(2 + \sin(2x))^\cos x]\left[(-\sin x)\left(\frac{2\cos(2x)}{2 + \sin(2x)}\right)\right]$?

(e) NONE OF THE ABOVE
D. (5 pts) (no partial credit) Suppose \( f'(x) = (x - 1)^2(x - 2)(x - 3)^2 \). Which of the following is a maximal interval of increase for \( f \)? Circle one of the following answers:

(a) \([2, \infty)\)
(b) \((2, \infty)\)
(c) \([1, \infty)\)
(d) \((-\infty, 1]\)
(e) NONE OF THE ABOVE

E. (5 pts) (no partial credit) Compute the derivative of \( \ln(x^{\arctan x}) \), with respect to \( x \), on the interval \( x > 0 \). Circle one of the following answers:

(a) \(x^{1/(1+x^2)}/x^{\arctan x}\)
(b) \(1/x^{\arctan x}\)
(c) \(1/x^{\sec^2 x}\)
(d) \(x^{\sec^2 x}\)
(e) NONE OF THE ABOVE

F. (5 pts) (no partial credit) Suppose \( f''(x) = -x^2 - 4x - 3 \). At most one of the following statements is true. If one is, circle it. Otherwise, circle "NONE OF THE ABOVE".

(a) \( f \) is concave up on \((-\infty, 1]\), down on \([1, 3]\) and up on \([3, \infty)\).
(b) \( f \) is concave down on \((-\infty, 1]\), up on \([1, 3]\) and down on \([3, \infty)\).
(c) \( f \) is concave up on \((-\infty, -3]\), down on \([-3, -1]\) and up on \([-1, \infty)\).
(d) \( f \) is concave down on \((-\infty, -3]\), up on \([-3, -1]\) and down on \([-1, \infty)\).
(e) NONE OF THE ABOVE
II. True or false (no partial credit):

a. (5 pts) Assume that \( \lim_{x \to 0} f(x) = 0 = \lim_{x \to 0} g(x) \). Assume also that \( \lim_{x \to 0} \left[ \frac{f(x)}{g(x)} \right] \) does not exist. Then \( \lim_{x \to 0} \left[ \frac{f(x)}{g(x)} \right] \) does not exist.

b. (5 pts) Assume that \( \lim_{x \to 3} f(x) = 0 = \lim_{x \to 3} g(x) \). Assume also that \( \lim_{x \to 3} \frac{f'(x)}{g'(x)} = 7 \). Then \( \lim_{x \to 3} \frac{f(x)}{g(x)} = 7 \).

c. (5 pts) If \( f' > 0 \) on an interval \( I \), then \( f \) is increasing on \( I \).

d. (5 pts) If \( f \) is increasing on an interval \( I \), then \( f' > 0 \) on \( I \).

e. (5 pts) If \( f \) and \( g \) are differentiable at a number \( a \), then \( fg + f + g \) is differentiable at \( a \).
III. Computations. Show work. Unless otherwise specified, answers must be exactly correct, but can be left in any form easily calculated on a standard calculator.

1. (5 pts) Compute \( \frac{d}{dx} \left[ \frac{e^{x^4} - 8}{5 + \csc(x^2)} \right] \). (Here \( e^{x^4} \) means \( e^{(x^4)} \).)

2. (5 pts) Compute \( \frac{d}{dx} \left[ (5 - \sin x)^{\arccos x} \right] \).
3. (10 pts) Find an equation for the tangent line to \( x^3 + xy + y^3 = 11 \) at \((1, 2)\).
4. (15 pts) Compute $\lim_{x \to 0} \left( (\cos x) - (\sin x) \right)^{3/x}$. 
5. (10 pts) Find the global maximum and minimum value of \( f(x) = x^3 - 3x^2 + 3x + 9 \) on the interval \(-1 \leq x \leq 1\).