PRINT YOUR NAME:

PRINT YOUR TA’S NAME:

WHAT RECITATION SECTION ARE YOU IN?

Closed book, closed notes, no calculators/PDAs; no reference materials of any kind. Turn off all handheld devices, including cell phones.

Show work; a correct answer, by itself, may be insufficient for credit. Arithmetic need not be simplified, unless the problem requests it.

I understand the above, and I understand that cheating has severe consequences, from a failing grade to expulsion.

SIGN YOUR NAME:
I. Multiple choice

A. (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) \((-\infty, 2]\)
(b) \([1, \infty)\)
(c) \((2, \infty)\)
(d) \([3, \infty)\)
(e) NONE OF THE ABOVE

B. (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 down on \((-\infty, 1]\), up on \([1, 3]\) and down on \([3, \infty)\).
(b) \( f \) is concave down on \((-\infty, \infty)\).
(c) \( f \) is concave down on \((-\infty, -3]\), up on \([-3, -1]\) and down on \([-1, \infty)\).
(d) \( f \) is concave up on \((-\infty, -3]\), down on \([-3, -1]\) and up on \([-1, \infty)\).
(e) NONE OF THE ABOVE

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

(a) \( 2[\sin(xy)][y + xy'] \)
(b) \( [\cos^2(xy)][y + xy'] \)
(c) \( 2[\sin(xy)][\cos(xy)][y + xy'] \)
(d) \( 2[\sin(xy)][\cos(y + xy')] \)
(e) NONE OF THE ABOVE
D. (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) \((-\sin x) \left( \frac{2\cos(2x)}{2 + \sin(2x)} \right)\)

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

(d) \((\cos x)(\ln(2 + \sin(2x)))\)

(e) NONE OF THE ABOVE

E. (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) \([(2 + \sin(2x))^{\cos x}] \left[ (-\sin x) \left( \frac{2\cos(2x)}{2 + \sin(2x)} \right) \right]\)

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

(d) \([(2 + \sin(2x))^{\cos x}] \left[ (\cos x)(\ln(2 + \sin(2x))) \right]\)

(e) NONE OF THE ABOVE

F. (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) \(\frac{1}{x^{\sec^2 x}}\)

(b) \(x^{\sec^2 x}\)

(c) \(\frac{1}{x^{\arctan x}}\)

(d) \(\frac{\ln x}{1 + x^2} + \frac{\arctan x}{x}\)

(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 \( \lim_{x \to 3} \left[ \frac{f'(x)}{g'(x)} \right] = 7 \). Then \( \lim_{x \to 3} \left[ \frac{f(x)}{g(x)} \right] = 7 \).

c. (5 pts) If \( f \) and \( g \) are differentiable at a number \( a \), then \( fg + f + g \) is differentiable at \( a \).

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

e. (5 pts) If \( f' > 0 \) on an interval \( I \), then \( f \) is increasing on \( I \).
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 \( \frac{d}{dx} \left[ (5 - \sin x)^7\arctan x \right] \).
3. (10 pts) Find an equation for the tangent line to \( x^3 + xy + y^3 = 11 \) at (2,1).
4. (15 pts) Compute \( \lim_{x \to 0} ((\cos x) + (\sin x))^{-2/x} \).
5. (10 pts) Find the global maximum and minimum value of \( f(x) = -x^3 + 3x^2 - 3x - 3 \) on the interval \( 0 \leq x \leq 1 \).