LAST NAME, First name (print): ________________________________

INSTRUCTOR: ________________________________

SECTION NUMBER: ____________

UIN: ________________________________

SEAT NUMBER: ________________________________

DIRECTIONS:

1. The use of a calculator, laptop or computer is prohibited.

2. In Part 1 (Problems 1-12), mark the correct choice on your ScanTron using a No. 2 pencil. For your own records, also record your choices on your exam!

3. In Part 2 (Problems 12-17), present your solutions in the space provided. Show all your work neatly and concisely and clearly indicate your final answer. You will be graded not merely on the final answer, but also on the quality and correctness of the work leading up to it.

4. Be sure to write your name, section number and version letter of the exam on the ScanTron form.

THE AGGIE CODE OF HONOR

“An Aggie does not lie, cheat or steal, or tolerate those who do.”

Signature: ________________________________

DO NOT WRITE BELOW!

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PART I: Multiple Choice

1. (4 pts) \[ \lim_{x \to 0} \frac{x - \arcsin(4x)}{x + \arctan x} = \]

(a) 0 
(b) \(\frac{1}{2}\) 
(c) \(-\frac{1}{2}\) 
(d) \(-\frac{3}{2}\) 
(e) \(\infty\)

2. (4 pts) Find all critical numbers for \(f(x) = x \ln x\).

(a) \(x = \frac{1}{e}\) 
(b) \(x = 0\) 
(c) \(x = e\) 
(d) \(x = 0\) and \(x = e\) 
(e) \(x = \frac{1}{e}\) and \(x = 0\).

3. (4 pts) Find \(f(\pi)\) if \(f'(x) = 3 \cos x - 5 \sin x\) and \(f(0) = 4\).

(a) \(f(\pi) = -6\) 
(b) \(f(\pi) = -5\) 
(c) \(f(\pi) = -4\) 
(d) \(f(\pi) = -3\) 
(e) \(f(\pi) = -2\)
4. (4 pts) \( \arctan \left( \tan \frac{4\pi}{3} \right) = \)

(a) \( \frac{4\pi}{3} \)
(b) \( \frac{2\pi}{3} \)
(c) \( \frac{\pi}{3} \)
(d) \( \frac{5\pi}{3} \)
(e) \( -\frac{\pi}{3} \)

5. (4 pts) Given the graph of the derivative, \( f'(x) \), of a function \( f(x) \) below, where is the graph of \( f(x) \) concave up?

(a) \( (0, \infty) \)
(b) \( (-\infty, b) \cup (d, \infty) \)
(c) \( (a, c) \cup (e, \infty) \)
(d) \( (-\infty, 0) \)
(e) \( (b, d) \)

6. (4 pts) Find \( \frac{dy}{dx} \) for \( y = x^{\sin x} \).

(a) \[ \frac{dy}{dx} = \cos x (\ln x)x^{\sin x} \]
(b) \[ \frac{dy}{dx} = \cos x \ln x + \frac{\sin x}{x} \]
(c) \[ \frac{dy}{dx} = x^{\sin x} \left( -\cos x \ln x + \frac{\sin x}{x} \right) \]
(d) \[ \frac{dy}{dx} = x^{\sin x} \left( \cos x \ln x + \frac{\sin x}{x} \right) \]
(e) \[ \frac{dy}{dx} = (\sin x)x^{\sin x - 1} \]
7. (4 pts) If \( \sum_{i=1}^{4} a_i = 3 \) and \( \sum_{i=1}^{4} b_i = -2 \), find \( \sum_{i=1}^{4} (a_i + 2b_i + 2) \)

(a) -3  
(b) -1  
(c) 3  
(d) 1  
(e) 7

8. (4 pts) Find the absolute maximum for \( f(x) = x^3 - 12x + 1 \) on the interval \([1, 3]\).

(a) -10  
(b) 17  
(c) -8  
(d) -15  
(e) 0

9. (4 pts) If \( f(x) = \ln(\arctan x) \), then \( f'(1) = \)

(a) \( \ln \frac{1}{2} \)  
(b) \( \frac{4}{\pi} \)  
(c) \( \frac{1}{8\pi} \)  
(d) \( \ln \frac{4}{\pi} \)  
(e) \( \frac{2}{\pi} \)
10. (4 pts) Where is \( f(x) = xe^{3x} \) increasing?

(a) \((-\infty, \infty)\)
(b) \((-\frac{1}{3}, \infty)\)
(c) \((-\infty, -\frac{1}{3})\)
(d) \((-3, \infty)\)
(e) \((-\infty, -3)\)

11. (4 pts) Find the \( x \) coordinate of the inflection point(s) for \( f(x) = x^4 - 6x^2 \).

(a) \( x = 0 \) and \( x = \pm \sqrt{3} \)
(b) \( x = 1 \)
(c) \( x = \pm \sqrt{3} \)
(d) \( x = \pm 1 \)
(e) \( x = -1 \)

12. (4 pts) \( \sin(\arctan x) = \)

(a) \( \frac{1}{\sqrt{1 + x^2}} \)
(b) \( \frac{x}{\sqrt{1 - x^2}} \)
(c) \( \frac{\sqrt{1 - x^2}}{x} \)
(d) \( \frac{1}{1 + x^2} \)
(e) \( \frac{x}{\sqrt{1 + x^2}} \)
PART II WORK OUT

Directions: Present your solutions in the space provided. Show all your work neatly and concisely and Box your final answer. You will be graded not merely on the final answer, but also on the quality and correctness of the work leading up to it.

13. (11 pts) Solve for \( x \): \( \log_4(x^2 - 16) - \log_4(1 - 2x) = 1 \)
14. (11 pts) Find \( \lim_{x \to \infty} (e^x + x)^{1/x} \).
15. (10 pts) Newton’s Law of Cooling states the rate of cooling of an object is proportional to the temperature difference between the object and the temperature of the object’s surroundings. A pie is taken from an oven where its temperature has reached 375°F and is placed on a table in a room where the temperature is 75°F. If the temperature of the pie is 200°F after 30 minutes, find a formula for the temperature of the pie at time \( t \), where \( t \) is measured in minutes.
16. (10 pts) Find the area of the largest rectangle that can be inscribed in a right triangle with legs of length 3 cm and 4 cm if two sides of the rectangle lie along the legs.
17. (10 pts) Approximate the area under the graph of \( f(x) = x^2 + 2 \), above the \( x \) axis, from \( x = -2 \) to \( x = 6 \) using 4 subintervals of equal width and left endpoints. Simplify your answer.