LAST NAME, First name (print):

INSTRUCTOR:

SECTION NUMBER:

UIN:

SEAT NUMBER:

DIRECTIONS:

1. The use of a calculator, laptop or computer is prohibited. http://www.math.tamu.edu/

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 13-17), 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!

<table>
<thead>
<tr>
<th>Question</th>
<th>Points Awarded</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1-12</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>10</td>
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PART I: Multiple Choice

1. (4 pts) \( \lim_{{x \to \infty}} \arccos \left( \frac{1 - x}{2x + 3} \right) = \)

(a) \( \frac{\pi}{3} \)
(b) \( \frac{\pi}{6} \)
(c) \( \frac{2\pi}{3} \)
(d) \( \frac{5\pi}{6} \)
(e) \( -\frac{\pi}{3} \)

2. (4 pts) If \( f'(x) = 3 \cos x + 5 \sin x \) and \( f(0) = 4 \), find \( f(\pi) \).

(a) \(-6 \)
(b) \(4 \)
(c) \(14 \)
(d) \(2 \)
(e) \(-7 \)

3. (4 pts) The critical numbers for \( f(x) = \sqrt{x^2 - 2x} \) are

(a) \( x = 1 \) only
(b) \( x = 1, x = 0 \) and \( x = 2 \) only
(c) \( x = 0 \) and \( x = 2 \) only
(d) \( x = 0 \) and \( x = 1 \) only
(e) \( x = 2 \) only
4. (4 pts) Find the absolute extrema for \( f(x) = x^3 - 12x + 1 \) on \([-3, 0]\).

(a) absolute maximum: 17; absolute minimum: -15
(b) absolute maximum: 10; absolute minimum: 1
(c) absolute maximum: 10; absolute minimum: -15
(d) absolute maximum: 17; absolute minimum: 1
(e) There is no absolute extrema.

5. (4 pts) Find \( \lim_{x \to 0} \frac{2^x - 5^x}{x} \)

(a) 0
(b) \( \infty \)
(c) 1
(d) \( \ln \frac{2}{5} \)
(e) \( \ln(10) \)

6. (4 pts) \( f(x) = x^2 e^x \) has:

(a) A local minimum \( x = 0 \) and no local maximum.
(b) A local maximum at \( x = 2 \) and a local minimum at \( x = 0 \).
(c) A local maximum at \( x = -2 \) and a local minimum at \( x = 0 \).
(d) A local maximum at \( x = -2 \) and no local minimum.
(e) A local maximum at \( x = 2 \) and no local minimum.
7. (4 pts) Evaluate \( \int_0^3 \sqrt{9-x^2} \, dx \) by interpreting the definite integral in terms of area.

(a) \( \frac{3\pi}{4} \)
(b) \( \frac{9\pi}{2} \)
(c) \( \frac{3\pi}{2} \)
(d) \( 3\pi \)
(e) \( \frac{9\pi}{4} \)

8. (4 pts) Use the midpoint rule with \( n = 4 \) to approximate \( \int_1^2 \ln x \, dx \)

(a) \( \ln \frac{9}{8} + \ln \frac{11}{8} + \ln \frac{13}{8} + \ln \frac{15}{8} \)
(b) \( \frac{1}{2} \left( \ln \frac{5}{4} + \ln \frac{7}{4} + \ln \frac{9}{4} + \ln \frac{11}{4} \right) \)
(c) \( \ln \frac{5}{4} + \ln \frac{7}{4} + \ln \frac{9}{4} + \ln \frac{11}{4} \)
(d) \( \frac{1}{4} \left( \ln \frac{9}{8} + \ln \frac{11}{8} + \ln \frac{13}{8} + \ln \frac{15}{8} \right) \)
(e) \( \frac{1}{2} \left( \ln \frac{9}{8} + \ln \frac{11}{8} + \ln \frac{13}{8} + \ln \frac{15}{8} \right) \)

9. (4 pts) A population of bacteria triples every 5 minutes. If the population follows the exponential growth model, \( y = y_0 e^{kt} \), find \( k \).

(a) \( \frac{\ln 2}{5} \)
(b) 3
(c) 5
(d) \( \frac{\ln 3}{5} \)
(e) Insufficient information
10. (4 pts) \( \frac{d}{dx} \int_{1}^{\ln x} \frac{dt}{\sqrt{t^3 + t}} = \)

(a) \( \frac{1}{\sqrt{(\ln x)^3 + \ln x}} \)

(b) \( \frac{2\sqrt{(\ln x)^3 + \ln x}}{x} \)

(c) \( \frac{1}{x\sqrt{(\ln x)^3 + \ln x}} \)

(d) \( 6x^2\sqrt{(\ln x)^3 + \ln x} \)

(e) \( 2\sqrt{(\ln x)^3 + \ln x} \)

11. (4 pts) Find \( f'(e) \) for \( f(x) = \ln(x + \ln x) \).

(a) \( \frac{1}{e + 1} \)

(b) \( \frac{1}{e} \)

(c) \( \frac{e + 1}{e^2} \)

(d) \( 2 \)

(e) \( \frac{2}{e} \)

12. (4 pts) \( \int_{1}^{4} \left( \sqrt{x} + \frac{1}{\sqrt{x}} \right)^2 \, dx = \)

(a) \( \frac{42}{3} \)

(b) \( \frac{13}{4} \)

(c) \( \frac{27}{2} + \ln 4 \)

(d) \( \frac{15}{2} + \ln 4 \)

(e) None of these.
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. (10 pts) Find \( \lim_{x \to \infty} \left( 1 - \frac{3}{x} \right)^x \).
14. (a) (4 pts) \( \sin \left( \arccos \left( \frac{4}{5} \right) \right) = \)

(b) (6 pts) Find the derivative of \( f(x) = \arctan(\arcsin x) \).

15. (8 pts) Suppose a particle is moving with acceleration \( \mathbf{a}(t) = \langle 1, 2t \rangle \), initial velocity \( \mathbf{v}(0) = \langle 1, -1 \rangle \) and initial position \( \mathbf{s}(0) = \langle 0, 1 \rangle \). Find the position, \( \mathbf{s}(t) \), at time \( t \).
16. (12 pts) Suppose 36 square feet of material is available to make a box with a closed top. The length of the base is 3 times the width. What are the dimensions of the box that maximizes the volume? Justify ALL steps.
17. If \( f(x) = x^4 - 6x^2 + 4 \):

(i) (5 pts) Find the intervals where \( f \) is increasing and decreasing.

(ii) (5 pts) Find the intervals where \( f \) is concave up and concave down.

(iii) (2 pts) Find the inflection points of \( f \).