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 1-10), 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 11-16), 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>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

|                |                | 100    |
1. (4 pts) In order to solve the equation $x^5 - 2x + 5 = 0$, we apply Newton’s Method with an initial guess $x_1 = 1$. What value does Newton’s Method give for $x_2$, the second approximation?

(a) $\frac{7}{3}$
(b) $\frac{1}{4}$
(c) $-\frac{1}{3}$
(d) $\frac{7}{4}$
(e) $-\frac{1}{4}$

2. (4 pts) $\lim_{\theta \to 0} \frac{\sin^2(3\theta)}{\theta^2} =$

(a) 9
(b) 3
(c) $\frac{1}{9}$
(d) $\frac{1}{3}$
(e) The limit does not exist
3. (4 pts) Find the tangent vector of unit length for \( r(t) = \langle e^{2t}, t \cos t \rangle \) at \( t = 0 \).

(a) \( \left\langle \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \right\rangle \)

(b) \( (2, 1) \)

(c) \( (1, 0) \)

(d) \( \left\langle \frac{2}{\sqrt{5}}, \frac{1}{\sqrt{5}} \right\rangle \)

(e) \( (1, 1) \)

4. (4 pts) Solve the equation \( \ln(x + e) + \ln(x - e) = 2 + \ln 3 \).

(a) \( x = 3e \) only

(b) \( x = 1 \) and \( x = 3e \)

(c) \( x = 2e \) only

(d) \( x = 2e \) and \( x = -2e \)

(e) No solution
5. (4 pts) If \( g \) is the inverse of \( f \), find \( g'(2) \) if it is known that \( f(3) = 2 \), \( f'(3) = 7 \), \( f(2) = 11 \) and \( f'(11) = 8 \). Assume \( g \) to be differentiable.

(a) \( \frac{1}{7} \)
(b) \( \frac{1}{11} \)
(c) \( \frac{1}{8} \)
(d) \( \frac{1}{2} \)
(e) \( \frac{1}{5} \)

6. (4 pts) If \( h(x) = f \circ g = f(g(x)) \), find \( h'(-3) \) given that \( g'(-3) = 4 \), \( f'(-3) = 7 \), \( g(-3) = -2 \), \( f'(-2) = 11 \), and \( f'(4) = -3 \)

(a) \( 28 \)
(b) \( 44 \)
(c) \( -14 \)
(d) \( -6 \)
(e) \( -3 \)
7. (4 pts) An object is moving with position function \( f(t) = 2 \sin t - 3 \cos t \). Find the velocity, \( v(t) \), and the acceleration, \( a(t) \), at \( t = \frac{\pi}{6} \).

(a) \( v \left( \frac{\pi}{6} \right) = -\sqrt{3} - \frac{3}{2} \) \hspace{1cm} a \left( \frac{\pi}{6} \right) = -1 + \frac{3}{2} \\
(b) \( v \left( \frac{\pi}{6} \right) = \sqrt{3} - \frac{3}{2} \) \hspace{1cm} a \left( \frac{\pi}{6} \right) = 1 - \frac{3\sqrt{3}}{2} \\
(c) \( v \left( \frac{\pi}{6} \right) = \sqrt{3} + \frac{3}{2} \) \hspace{1cm} a \left( \frac{\pi}{6} \right) = -1 + \frac{3\sqrt{3}}{2} \\
(d) \( v \left( \frac{\pi}{6} \right) = \sqrt{3} - \frac{\sqrt{3}}{2} \) \hspace{1cm} a \left( \frac{\pi}{6} \right) = 1 - \frac{3\sqrt{3}}{2} \\
(e) \( v \left( \frac{\pi}{6} \right) = 1 + \frac{3\sqrt{3}}{2} \) \hspace{1cm} a \left( \frac{\pi}{6} \right) = -\sqrt{3} + \frac{3}{2} \\

8. (4 pts) If \( Q(x) \) is the quadratic approximation for \( f(x) = \frac{2}{x} \) at \( x = 1 \), then \( Q \left( \frac{1}{2} \right) = 

(a) 3 \\
(b) \frac{5}{2} \\
(c) \frac{3}{2} \\
(d) \frac{7}{2} \\
(e) \frac{9}{2} 

9. (4 pts) Evaluate $\lim_{x \to 0^-} e^{1/x}$

(a) 1
(b) 0
(c) $\infty$
(d) $-\infty$
(e) $e$

10. (4 pts) Find the inverse function of $f(x) = \frac{1 - x}{4x + 3}$

(a) $f^{-1}(x) = \frac{1 - 3x}{4x + 1}$
(b) $f^{-1}(x) = \frac{3x - 1}{4x + 1}$
(c) $f^{-1}(x) = \frac{4x + 3}{1 - x}$
(d) $f^{-1}(x) = \frac{1 - 3x}{4x}$
(e) $f^{-1}(x) = \frac{3x - 1}{4x}$
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.

11. Find the derivative of:
   (i) (6 pts) \( f(x) = \tan^3(x) + \tan(x^3) \)
   (ii) (6 pts) \( g(t) = \sqrt{1 + \sqrt{t}} \).
12. (10 pts) Water is poured into a conical cup at the rate of \( \frac{3}{2} \) cubic inches per second. If the cup is 6 inches tall and the top of the cup has a radius of 2 inches, how fast does the water level rise when the water is 4 inches deep? Be sure to include units with your answer. NOTE: The volume of a cone is \( V = \frac{1}{3} \pi r^2 h \).
13. (10 pts) Find the equation of the tangent line to the curve $y^2 \sin 2x = 8 - 2y$ at the point $\left( \frac{\pi}{4}, 2 \right)$. 

14. Consider the curve given by parametric equations \( x = t^2 - 10t, \ y = t^3 - 3t^2 \).
   (i) (6 pts) Find the equation of the tangent line at \( t = 1 \).

(ii) (6 pts) Find all points on the curve where the tangent line is:
   (a) vertical
   (b) horizontal
15. (8 pts) Use differentials or a linear approximation to approximate $\sqrt{16.03}$.

16. (8 pts) Find all value(s) of $x$, $0 \leq x \leq 2\pi$, where $f(x) = x + 2\sin x$ has a horizontal tangent.