MATH 151, FALL 2015  
COMMON EXAM I - VERSION A

LAST NAME: ___________________________ FIRST NAME: _________________________

INSTRUCTOR: __________________________

SECTION NUMBER: _________________

UIN: _______________________________

DIRECTIONS:

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

2. TURN OFF cell phones and put them away. If a cell phone is seen during the exam, your exam will be collected and you will receive a zero.

3. In Part 1 (Problems 1-15), mark the correct choice on your ScanTron using a No. 2 pencil. The ScanTron will not be returned, therefore for your own records, also record your choices on your exam! Each problem is worth 4 points.

4. In Part 2 (Problems 16-20), 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.

5. 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. 4 points each

1. \( \lim_{{x \to +\infty}} \frac{(3x - 2)(x + 5)}{(3 - x)(1 + 2x)} = \)
   (a) \( \frac{3}{2} \)
   (b) 3
   (c) \( \frac{5}{3} \)
   (d) 1
   (e) \( \frac{3}{2} \)

2. Given the graph of \( f(x) \) shown below, which of the following statements is true?

   (a) \( f(x) \) is not continuous at \( x = -8 \) because \( \lim_{{x \to -8}} f(x) \) does not exist.
   (b) \( f(x) \) is not continuous at \( x = -2 \) because \( \lim_{{x \to -2}} f(x) = \infty \).
   (c) \( f(x) \) is not continuous at \( x = 6 \) because \( f(6) \) does not exist.
   (d) \( f(x) \) is not continuous at \( x = -8 \) because \( \lim_{{x \to -8}} f(x) \neq f(-8) \).
   (e) All of the above statements are false.

3. Which of the following is a set of parametric equations for the line passing through the point \((4, -7)\) and perpendicular to the line \(3x + 4y = -8\)?
   (a) \( x = 4 + 3t, \ y = -7 + 4t \)
   (b) \( x = 4 + 4t, \ y = -7 + 3t \)
   (c) \( x = 4 + 3t, \ y = -7 - 4t \)
   (d) \( x = 3t, \ y = -2 + 4t \)
   (e) \( x = 4 - 4t, \ y = -7 + 3t \)
4. \( \lim_{x \to -\infty} \frac{-5x + 2}{\sqrt{4x^2 + x + 4}} = \)

(a) \( \frac{5}{2} \)

(b) \( -\frac{5}{4} \)

(c) \( 5 \)

(d) \( \frac{5}{4} \)

(e) None of the above

5. A 100 pound weight is suspended by two wires, \( T_1 \) and \( T_2 \), as shown below. Which of the following equations must be solved in order to find the magnitude of the tension in each wire?

(a) \(|T_2| \cos(33^\circ) - |T_1| \cos(50^\circ) = 100\) and \(|T_2| \sin(33^\circ) - |T_1| \sin(50^\circ) = 0\)

(b) \(|T_2| \cos(33^\circ) + |T_1| \cos(50^\circ) = 100\) and \(|T_2| \sin(33^\circ) + |T_1| \sin(50^\circ) = 0\)

(c) \(|T_2| \cos(33^\circ) - |T_1| \cos(50^\circ) = 0\) and \(|T_2| \sin(33^\circ) + |T_1| \sin(50^\circ) = 100\)

(d) \(|T_2| \cos(33^\circ) + |T_1| \cos(50^\circ) = 0\) and \(|T_2| \sin(33^\circ) + |T_1| \sin(50^\circ) = 100\)

(e) \(|T_2| \cos(33^\circ) - |T_1| \cos(50^\circ) = 0\) and \(|T_2| \sin(33^\circ) - |T_1| \sin(50^\circ) = 100\)

6. Find the average rate of change of \( f(x) = \tan x \) over the interval \( \left[ 0, \frac{\pi}{4} \right] \).

(a) \( 1 \)

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

(c) \( \frac{\pi}{4} \)

(d) \( \frac{2}{\pi} \)

(e) \( \frac{1}{2} \)
7. A man uses a horizontal force of 20 pounds on a box as he pushes it up a ramp that is 7 feet long and is inclined at an angle of 60° above the horizontal. Find the work done.

(a) 70 foot pounds
(b) 140 foot pounds
(c) $140\sqrt{3}$ foot pounds
(d) $70\sqrt{2}$ foot pounds
(e) $70\sqrt{3}$ foot pounds

8. $\lim_{t\to 4} \frac{t^2 - 16}{\sqrt{t} - 2} =$

(a) 8
(b) 4
(c) 16
(d) 32
(e) The limit does not exist.

9. Consider the triangle with vertices $A(1, 3)$, $B(2, 1)$ and $C(-2, 0)$. Find the angle, $\alpha$, located at vertex $A$, that is $\angle BAC$.

(a) $\alpha = \arccos \left( \frac{-1}{\sqrt{10}} \right)$
(b) $\alpha = \arccos \left( \frac{3}{\sqrt{10}} \right)$
(c) $\alpha = \arccos \left( \frac{-3}{\sqrt{30}} \right)$
(d) $\alpha = \arccos \left( \frac{1}{\sqrt{10}} \right)$
(e) $\alpha = \arccos \left( \frac{3}{\sqrt{30}} \right)$
10. Find the vector projection of $2\mathbf{i} - \mathbf{j}$ onto $3\mathbf{i} + \mathbf{j}$.

(a) $3\mathbf{i} + \mathbf{j}$
(b) $\frac{3}{2}\mathbf{i} + \frac{1}{2}\mathbf{j}$
(c) $\frac{15}{\sqrt{10}}\mathbf{i} + \frac{5}{\sqrt{10}}\mathbf{j}$
(d) $3\sqrt{5}\mathbf{i} + \sqrt{5}\mathbf{j}$
(e) $\frac{3}{\sqrt{2}}\mathbf{i} + \frac{1}{\sqrt{2}}\mathbf{j}$

11. $\lim_{x \to -8} \frac{x - 9}{x(x + 8)} =$

(a) $\infty$
(b) 0
(c) 1
(d) $-\infty$
(e) does not exist

12. If $f(x) = x^2 - 4x + 1$, what is $\lim_{h \to 0} \frac{f(3+h) - f(3)}{h}$?

(a) 10
(b) 2
(c) 1
(d) 3
(e) 6
13. Find the vertical asymptote(s) for the function \( f(x) = \frac{x^3 + 2x^2 - 3x}{x^2 + x - 2} \)

   (a) \( x = 1 \) and \( x = -2 \) only
   (b) \( x = -2 \) only
   (c) \( x = -3 \) and \( x = 0 \) only
   (d) \( x = -2, x = -3 \) and \( x = 0 \) only
   (e) \( x = 1 \) only

14. Suppose \( s \) and \( w \) are real numbers and let \( \mathbf{a} = \langle 3s, 7 \rangle \) and \( \mathbf{b} = \langle -2, 5w \rangle \). If \( \mathbf{a} \) is perpendicular to \( \mathbf{b} \), what is the relationship between \( s \) and \( w \)?

   (a) \( -6s + 35w = 1 \)
   (b) \( 3s - 5w + 2 = 0 \)
   (c) \( -6s + 35w = 0 \)
   (d) \( -6s + 35w = 90 \)
   (e) \( 3s + 5w + 11 = 0 \)

15. Which of the following intervals contains a solution to the equation \( x^3 + 2x^2 - 42 = 0 \)?

   (a) \((-2, 0)\)
   (b) \((-1, 0)\)
   (c) \((0, 1)\)
   (d) \((1, 2)\)
   (e) \((2, 3)\)
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.

16. (i) (8 pts) If \( f(x) = \frac{3}{4x - 1} \), Using the Limit Definition of the Derivative, show that \( f'(x) = \frac{-12}{(4x - 1)^2} \)

(ii) (4 pts) Find the equation of the tangent line to the graph of \( f(x) \) at \( x = -2 \).
17. Find the limit, if it exists. **If it does not exist, explain why.**

(i) (3 pts) \[ \lim_{x \to 3^-} \frac{|x - 3|}{x^2 - 4x + 3} \]

(ii) (3 pts) \[ \lim_{x \to 3^+} \frac{|x - 3|}{x^2 - 4x + 3} \]

(iii) (2 pts) \[ \lim_{x \to 3} \frac{|x - 3|}{x^2 - 4x + 3} \]
18. Consider \( f(x) = \begin{cases} 
ax^2 + 2x & \text{if } x < 2 \\
K & \text{if } x = 2 \\
x^3 + ax - 3 & \text{if } x > 2 
\end{cases} \)

(i) (2 pts) Find \( \lim_{x \to 2^-} f(x) \) in terms of \( a \).

(ii) (2 pts) Find \( \lim_{x \to 2^+} f(x) \) in terms of \( a \).

(iii) (2 pts) For what value of \( a \) does \( \lim_{x \to 2} f(x) \) exist?

(iv) (2 pts) Using the value of \( a \) found above, for what value of \( K \) is \( f(x) \) continuous?
19. (6 pts) Sketch the graph of \( x = t + 2, \ y = t^2 + 1, \ -2 \leq t < 1 \) on the grid provided below.

20. (6 pts) Find the cartesian equation of the curve \( x = 1 + \cos t, \ y = 3 + \sin t, \ 0 \leq t \leq 2\pi \). Your answer must not be in terms of inverse trig functions.