MA 213 — Calculus III Fall 2016
Exam 2 October 19, 2016

Name: _____

Section: _____

Last 4 digits of student ID #: _____

- No books or notes may be used.
- Turn off all your electronic devices and do not wear ear-plugs during the exam.
- You may use a calculator, but not one which has symbolic manipulation capabilities or a QWERTY keyboard.
- Additional blank sheets for scratch work are available upon request.
- **Multiple Choice Questions:**
  Record your answers on the right of this cover page by marking the box corresponding to the correct answer.
- **Free Response Questions:**
  Show all your work on the page of the problem. Clearly indicate your answer and the reasoning used to arrive at that answer.

Multiple Choice Answers

Question					
1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E

Exam Scores

Question	Score	Total
MC		30
6		10
7		10
8		10
9		10
10		10
11		10
12		10
Total		100

Unsupported answers for the free response questions may not receive credit!

Record the correct answer to the following problems on the front page of this exam.

1. (6 points) Suppose $f(x, y, z)$ is a differentiable function,

$$x(u, v, w) = 2u - v^2 + w, \quad y(u, v, w) = v^2 - 4u - w^2, \quad z(u, v, w) = 2uvw.$$

and

$$g(u, v, w) = f(x(u, v, w), y(u, v, w), z(u, v, w)).$$

Use the following table of values to calculate $g_u(0, 1, 1)$, $g_v(0, 1, 1)$, and $g_w(0, 1, 1)$:

	f	g	f_x	f_y	f_z
$(0, 0, 0)$	3	5	-1	3	2
$(1, 1, 1)$	5	4	2	5	-1
$(0, 1, 1)$	4	1	4	-1	-1
$(1, 1, 0)$	2	7	3	2	-1

A. $g_u(0, 1, 1) = 10,\ g_v(0, 1, 1) = -10,\ g_w(0, 1, 1) = 6.$

B. $g_u(0, 1, 1) = -18,\ g_v(0, 1, 1) = 6,\ g_w(0, 1, 1) = 8.$

C. $g_u(0, 1, 1) = -4,\ g_v(0, 1, 1) = -2,\ g_w(0, 1, 1) = -1.$

D. $g_u(0, 1, 1) = -10,\ g_v(0, 1, 1) = 8,\ g_w(0, 1, 1) = -7.$

E. $g_u(0, 1, 1) = -18,\ g_v(0, 1, 1) = -2,\ g_w(0, 1, 1) = -7.$

Record the correct answer to the following problems on the front page of this exam.

2. (6 points) Suppose $(2, 3)$ is a critical point of a function f with continuous second derivatives and

$$f_{xx}(2, 3) = 18, \quad f_{xy}(2, 3) = -3, \quad f_{yy}(2, 3) = -4,$$

What does the second derivative test say about f at $(2, 3)$?

A. f has a local maximum at $(2, 3)$.

B. f has an absolute maximum at $(2, 3)$.

C. f has a local minimum at $(2, 3)$.

D. f has a saddle point at $(2, 3)$.

E. The second derivative test is inconclusive.

Record the correct answer to the following problems on the front page of this exam.

3. (6 points) The equation of the tangent plane to the graph of $z = \sqrt{9 + x^2y^2}$ at the point $(2, 2, 5)$ is written in the form $8x + by + cz = d$. Find d.

A. $d = 0$.

B. $d = 9$.

C. $d = -9$.

D. $d = 7$.

E. $d = -7$.

Record the correct answer to the following problems on the front page of this exam.

4. (6 points) The function $z = \sqrt{\ln(x^2 - y^2)}$ is defined and continuous in a region $D \subset \mathbf{R}^2$ bounded by a curve C. Describe C:

A. C is a circle.

B. C is a parabola.

C. C is two intersecting lines.

D. C is an ellipse.

E. C is a hyperbola.

Record the correct answer to the following problems on the front page of this exam.

5. (6 points) The directional derivative of

$$f(x, y) = \frac{x}{x^2 + y^2}$$

in the direction of $\mathbf{v} = \langle 3, 4 \rangle$ at the point $(1, 2)$ is

A. 0.

B. $7/25$.

C. $-7/25$.

D. $7/125$.

E. $-7/125$.

6. (10 points) Find the limit if it exists or show that it does not exist:

$$\text{(a)} \lim_{(x,y)\to(2,-1)} \frac{x^2y + xy^2}{x^3 - y^3}, \qquad \text{(b)} \lim_{(x,y)\to(0,0)} \frac{x^2y + xy^2}{x^3 + y^3}.$$

7. (10 points) Let

$$f(x, y) = \frac{1 + y}{1 + x}.$$

(a) Find the linearization of f at the point $(1, 3)$.
(b) Use the result in (a) to approximate $f(0.99, 3.02)$. [Note: No credit will be given if another method is used!]

8. (10 points) Find the absolute maximum and minimum values of $f(x, y) = xy - 4x$ in the region bounded by the x-axis and the parabola $y = 16 - x^2$.

9. (10 points) Calculate $f_x(x, y)$ and $f_y(x, y)$ if

$$f(x, y) = x^2 y \sin\left(\frac{x}{y}\right).$$

10. (10 points) Use Lagrange multipliers to find the absolute maximum and minimum values of $f(x, y) = x^4 + y^4$ on the circle $x^2 + y^2 = 1$. [Note: No credit will be given if another method is used!]

11. (10 points) Use gradients to find an equation for the tangent plane to the surface $xy + yz + xz = 11$ at the point $(1, 2, 3)$. Write the equation in the form $ax + by + cz = d$.

12. (10 points) Use implicit differentiation to find $\partial z/\partial x$ and $\partial z/\partial y$ if $e^{2z} = xyz$.