MA 213 — Calculus III Fall 2016
Exam 3 November 16, 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) A point in space has rectangular coordinates $(-1, -\sqrt{3}, 2\sqrt{3})$. Find its spherical coordinates (ρ, θ, ϕ).

A. $\rho = 4,\ \theta = \pi/6,\ \phi = \pi/3.$

B. $\rho = 4,\ \theta = \pi/3,\ \phi = \pi/6.$

C. $\rho = 4,\ \theta = 4\pi/3,\ \phi = \pi/6.$

D. $\rho = 4,\ \theta = 2\pi/3,\ \phi = -\pi/6.$

E. $\rho = 4,\ \theta = 2\pi/3,\ \phi = \pi/6.$

2. (6 points) Find the cylindrical coordinates of a point whose rectangular coordinates are $(1, -1, -1)$.

A. $(\sqrt{2}, 5\pi/4, -1).$

B. $(\sqrt{3}, 5\pi/4, -1).$

C. $(\sqrt{2}, 3\pi/4, -1).$

D. $(\sqrt{3}, 7\pi/4, -1).$

E. $(\sqrt{2}, 7\pi/4, -1).$

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

3. (6 points) Let E be the solid above the cone $z = \sqrt{x^2 + y^2}$ and below the sphere $x^2 + y^2 + z^2 = z$. Which of the following iterated integrals evaluates

$$\iiint_E f(x, y, z)\, dV$$

in spherical coordinates?

A.

$$\int_0^{\pi/2} \int_0^{2\pi} \int_0^{\cos\phi} f(\rho\sin\phi\cos\theta, \rho\sin\phi\sin\theta, \rho\cos\phi)\, \rho^2 \sin\phi\, d\rho\, d\theta\, d\phi.$$

B.

$$\int_0^{\pi/4} \int_0^{2\pi} \int_0^{\sin\phi} f(\rho\sin\phi\cos\theta, \rho\sin\phi\sin\theta, \rho\cos\phi)\, \rho^2 \sin\phi\, d\rho\, d\theta\, d\phi.$$

C.

$$\int_0^{\pi/2} \int_0^{2\pi} \int_0^{\sin\phi} f(\rho\sin\phi\cos\theta, \rho\sin\phi\sin\theta, \rho\cos\phi)\, \rho^2 \sin\phi\, d\rho\, d\theta\, d\phi.$$

D.

$$\int_0^{\pi/4} \int_0^{2\pi} \int_0^{\cos\phi} f(\rho\sin\phi\cos\theta, \rho\sin\phi\sin\theta, \rho\cos\phi)\, \rho^2 \sin\phi\, d\rho\, d\theta\, d\phi.$$

E.

$$\int_0^{\pi/2} \int_0^{2\pi} \int_0^{\cos\phi} f(\rho\sin\phi\cos\theta, \rho\sin\phi\sin\theta, \rho\sin\phi)\, \rho^2 \cos\phi\, d\rho\, d\theta\, d\phi.$$

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

4. (6 points) The area of the part of the plane $2x+2y+z=1$ inside the cylinder $x^2+y^2 \leq 9$ is

A. π

B. 3π

C. 9π

D. 27π

E. none of the above

5. (6 points) The spherical coordinates (ρ, θ, ϕ) of a point in space are $(1, \pi/3, \pi/6)$. Then the cylindrical coordinates of the point are:

A. $(1/2, \pi/3, \sqrt{3}/4)$

B. $(\sqrt{3}/2, \pi/3, \pi/6)$

C. $(\sqrt{3}/2, \pi/6, \pi/6)$

D. $(\sqrt{2}/2, \pi/3, \sqrt{6}/4)$

E. $(1/2, \pi/3, \sqrt{3}/2)$

Free Response Questions: Show your work!

6. (10 points) Find the area of the region inside the circle $r = 3\cos\theta$ and outside the cardioid $r = 1 + \cos\theta$.

Free Response Questions: Show your work!

7. (10 points) Use triple integrals to find the volume of the tetrahedron bounded by the planes $x = y$, $y = 1$, $z = 0$, and $x - 2y + z = 0$.

Free Response Questions: Show your work!

8. (10 points) Find the moment of inertia I_y of a lamina shaped as the circular sector $E = \{(x, y) \mid x \geq 0, y \geq 0, x^2 + y^2 \leq 4\}$, if the density at (x, y) is $\rho(x, y) = y$.

9. (10 points) Find the average value of the function $f(x, y) = \sqrt{x^2 + y^2}$ over the plane region between the circles $x^2 + y^2 \leq 1$ and $x^2 + y^2 \leq 4$.

10. (10 points) Change the order of integration in

$$\int_{-1}^{1} \int_{0}^{1-x^2} f(x, y)\, dy\, dx.$$

11. (10 points) Evaluate

$$\iint_E \frac{e^y}{y}\, dA,$$

where E is the triangle bounded by the lines $y = x$, $y = 2x$, and $y = 2$.

Free Response Questions: Show your work!

12. (10 points) Use geometry and symmetry to evaluate

$$\iint_E (3 + \sin(y^3))\, dA,$$

where E is the disk $\{(x, y) \mid x^2 + y^2 \leq 4\}$. [Be sure to justify your answer.]