Math 126 C - Spring 2013
Exam 2
May 21, 2013

Name: _____

Section: _____

Student ID Number: _____

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- You are allowed to use a scientific calculator (**NO GRAPHING CALCULATORS**) and one **hand-written** 8.5 by 11 inch page of notes. Put your name on your sheet of notes and turn it in with the exam.

- Check that your exam contains all the problems listed above.

- Clearly put a box around your final answers and cross off any work that you don't want us to grade.

- Show your work. The correct answer with no supporting work may result in no credit. Guess and check methods are not sufficient, you must use appropriate methods from class.

- Unless otherwise indicated, your final answer should be given in exact form whenever possible.

- Cheating will not be tolerated. Keep your eyes on your exam!

- You have 50 minutes to complete the exam. Use your time effectively, spend less than 10 minutes on each page and make sure to leave plenty of time to look at every page. Leave nothing blank, show me what you know!

GOOD LUCK!

1. (13 pts) A particle is moving in such a way that it's acceleration is given by $\mathbf{a}(t) = \langle 4, \sin(t), e^t \rangle$. The initial velocity is $\mathbf{v}(0) = \langle -6, 2, 0 \rangle$.

   (a) (5 pts) Find the curvature, κ, at time $t = 0$.

   (b) (8 pts) Assume the particle starts at $\mathbf{r}(0) = \langle 0, 2, 3 \rangle$ (so it starts on the yz-plane). The particle will pass through the yz-plane again at some later time. Find the (x, y, z) coordinates at which the particle passes through the yz-plane again. (Hint: First find $\mathbf{r}(t)$).

2. (The two problems below are unrelated)

   (a) (7 pts) Set up and evaluate a double integral to find the volume of the solid below the surface $z - 3x^2y - 1 = 0$, above the surface $z = 1$ and between the planes $x = 0$, $y = 2$, and $y = 2x$.

   (b) (7 pts) Evaluate the integral by reversing the order of integration: $\displaystyle \int_0^4 \int_{\sqrt{x}}^2 \frac{x}{y^5 + 1} \, dy \, dx$.

3. (10 pts) A lamina occupies the region R in the first quadrant that is above the line $y = x$ and between the circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 4$ (as shown below). The density is proportional to the distance from the origin.

Find the y-coordinate of the center of mass, $\bar{y}$. (Give your final answer as a decimal to 4 digits).

$y = x$
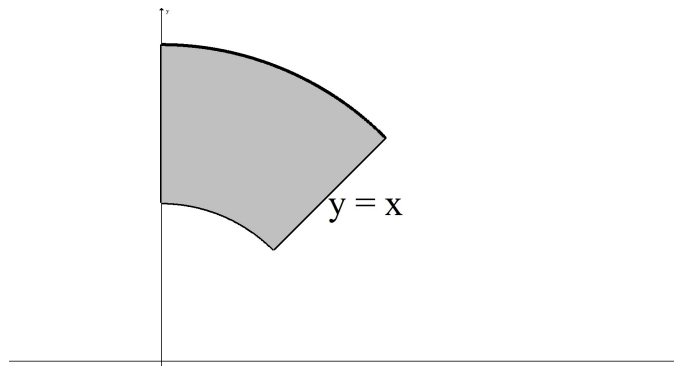
4. (13 pts) You are designing a cage to hold your pet rabbits. The cage is a rectangular box with a bottom, four sides, and one divider in the middle (you are keeping the males and females apart). There is no top. A picture of such a cage is below.

If you want the total combined volume to be 12 cubic feet, then what dimensions will minimize the total material used?

Give your final dimensions as decimals to four digits. As part of your answer, **use the second derivative test** to verify that your critical point is a local minimum.