MA205, Homework 2: 25 points

- This homework is due on Tuesday, 30 October 2007 at the start of class.
- Turn in a title page with name, section, and new documentation policy statement along with your work. You do not need to use a brown bomber.
- The following assignment is individual graded homework in that every keystroke you turn in is from you. DO NOT CUT AND PASTE other code into the computer. You can use whatever code you find and copy exactly, but YOU MUST TYPE IT YOURSELF. You need not document Schaum's or anything that I have sent you. Only let me know where you received your help.
- This assignment is to be completely executed in Mathematica and your submission will be a document with your executed homework file pasted into the document to show graphs and plots (if applicable).

PICK TWO (2) PROBLEMS FROM PROBLEMS 1-5

1. **[12 pts]** Major Bowman is going to brew a batch of beer and has some calculations to make to decide if his equipment and supplies are adequate. Major Bowman has a yeast culture in a nutrient package and wants to know what the volume of the package is to determine if the yeast will have enough nutrients. The package looks like a round bag sealed on each end and all blown up inside from the yeast activity. The bag's top layer can by described as $z = 8 - x^2 - y^2$ and the bottom layer as $z = x^2 + y^2$. Graph the bag and determine the volume of the bag. Units are in inches.

2. **[12 pts]** Major Bowman pours the culture of yeast precisely in the middle of a square fermenting vessel with each side of length 4 feet. The yeast culture was placed at the point (0,0), and yeast multiplies and disperses in such a matter that the concentration at any point (x,y) in the vessel is given by $C(x, y) = 1000000(300 - 3x^2 - 3y^2)$, where $C(x, y)$ is the number of yeast cells per square foot of surface of beer (x, y) in the vessel. Find the total concentration of yeast and the average concentration of yeast on the surface of the beer and plot the concentration as density or contour over the surface of the fermenter.

3. **[12 pts]** Major Bowman brews his beer near the laundry room and Cindy Bowman, Major Bowman's wife, does laundry every Monday. The Monday after brewing beer Cindy accidently dropped baking soda on the surface of the square fermenting vessel. Fortunately she only dropped a small amount on the surface of the beer and the yeast only died where she dropped the baking soda. The baking soda fell in a pattern following the equations
$y = 2 - \frac{1}{2}x^2, (-2 \leq x \leq 2)$ on the top half of the fermenter surface and
$y = -2 - x, (-2 \leq x < 0)$ and $y = x - 2, (0 \leq x \leq 2)$ on the bottom half of the fermenter surface. Find the total concentration of yeast if the yeast disperses as before and was placed in the middle of the fermenter. Again give a plot of the concentration as density or contour over the surface of the fermenter.

4. **[12 pts]** The next step in the brewing process is to transfer the beer from the square fermenter to a cylindrical fermenter called a carboy whose surface can be described by $x^2+y^2 \leq (\frac{10.5}{2})^2$. When this is done the baking soda is removed so the yeast covers the entire surface and has turned most of the sugar in the wort into alcohol. However, the yeast needs another week to complete the process. The concentration of yeast cells is now given by $C(x,y) = 1000000(300 - 5x^2 - 5y^2)$. Find the total concentration of yeast and plot it as a density or contour plot.

5. **[12 pts]** The last step in the brewing process before drinking the beer is to put the beer in the keg and carbonate it. At this time many brewers dry hop the beer. This is done by putting dry hops in a cheese cloth bag in the bottom of the keg and pouring the beer on top of it. The keg's surface is given by the equation $x^2 + y^2 \leq 16$ and the keg is 26 inches high. The yeast bag acts strangely and travels through the keg as a function of time in hours, where $x(t) = \cos[t]$, $y(t) = \sin[t]$, and $z(t) = t^3$. Plot the path of the yeast bag. At what time will the yeast bag reach the top of the keg?

6. **Bonus: [5 pts]** The very last step in the process is of course drinking the beer. Create an interesting formula about this last process. Write it up in Mathematica and give a plot. The amount of beer is usually about 5 gallons and ranges from 5% to 7% alcohol.

7. **Bonus: [5 pts]** Do a third problem from problems 1-5.