WRITTEN HOMEWORK #3, DUE 1/27/2012 AT 4PM

You may turn this assignment at the homework boxes on the bottom floor of Kemeny or at the beginning of class on Friday. Please staple your assignment before turning it in. Remember that you need to provide correct and reasonably complete details to receive full credit. The problems are taken from the 7th edition of Stewart's *Calculus*, although occasionally a problem will be modified to be slightly different from its textbook counterpart.

(1) (Problem #54, Chapter 15.3) Evaluate the following integral by interchanging the order of integration:

$$\int_0^8 \int_{\sqrt[3]{y}}^2 e^{x^4} \, dx \, dy.$$

(2) (Problem #28, Chapter 15.4)
   (a) A cylindrical drill with radius r_1 is used to bore a hole through the center of a sphere with radius r_2. Find the volume of the ring-shaped solid that remains.
   (b) Express the volume in part (a) in terms of the height h of the ring. Notice that the volume only depends on h, not on r_1 or r_2.

(3) (Problem #38, Chapter 15.4) Let D be the disk with center at the origin and radius a. What is the average distance from points in D to the origin?

(4) (Problem #30, Chapter 15.5)
   (a) A lamp has two bulbs of a type with an average lifetime of 1000 hours. Assuming that we can model the probability of failure of these bulbs by an exponential density function with mean $\mu = 1000$ (see Chapter 8.5 and also the formula at the top of page 1034), find the probability that both of the lamp's bulbs fail within 1000 hours.
   (b) Another lamp has just one bulb of the same type as in part (a). If the first bulb burns out, it is replaced by a second bulb of the same type. Find the probability that both bulbs fail within 1000 hours.

(5) (Problem #32, Chapter 15.5) Xavier and Yolanda both have classes that end at noon and they agree to meet every day after class. They arrive at a coffee shop independently. Xavier's arrival time is X and Yolanda's arrival time is Y, where X, Y are measured in minutes after noon. The individual density functions are

$$f_1(x) = \begin{cases} e^{-x} & \text{if } x \geq 0, \\ 0 & \text{if } x < 0 \end{cases}, f_2(y) = \begin{cases} \frac{1}{50}y & \text{if } 0 \leq y \leq 10 \\ 0 & \text{otherwise.} \end{cases}$$

After Yolanda arrives, she will wait for up to half an hour for Xavier, but he won't wait for her. Find the probability that they meet.

(6) (Problem #10, Chapter 15.6) Find the surface area of the part of the sphere $x^2 + y^2 + z^2 = 4$ that lies above the plane $z = 1$.