1. For the following, sketch the regions and *set up* the integrals which represent the volume using the shell method *and* disc method (i.e. set up the integrals two ways). Decide which integral would be easier to calculate (you don't have to compute the integral, but think about what method you would use and which seems easier).

   (a) the region bounded by $y = \cos(x^2)$, $x = 0$, $x = \sqrt{\pi}$, $y = 0$ rotated around the y-axis;

   (b) the region bounded by $y = \cos x$, $y = \sin x$, $x = 0$, $x = \frac{\pi}{4}$ rotated about the x-axis;

   (c) the region bounded by $9 - x = (y - 3)^2$, $x = 0$ rotated about the x-axis;

2. The Napkin Ring Problem. Consider a sphere of radius R with a cylindrical hole drilled through it with total length (or height) H. The shape left over can be thought of as a napkin ring.

   (a) Which do you think will have greater volume, the case where R=20 and H=10 or the case where R=30 and H=10? Sketch a picture of each, and see how the shape changes as R changes.

   (b) Calculate the volume of a napkin ring with radius of the sphere R and height of the hole H. (It might be helpful to call the radius of the cylinder r).

   (c) Was your intuition in the first part correct? Do you find your answer surprising at all?