1. Is there a quiz every Thursday?
   No, we will have a quiz every 2-3 weeks. I will e-mail you by the Monday before our recitation to let you know whether or not there will be a quiz. If I do not e-mail you by Monday evening let me know.

2. Who is your favorite rapper and why?
   Eazy-E, he was legit.

3. Are there specific situations where the shell method would be more useful than disk or washers?
   Yes there are. In fact, there are some volumes that can be computed by the shell method but not the washer or disk method. For example, consider the region bounded by $y = x^3 + 4x^2 + x + 3$ and $y = 4$. Now revolve this around the $y$-axis and find the volume of the solid obtained. Do not try to do this problem (the numbers are not nice). Do graph the functions and notice that it is very hard to figure out exactly what the outer and inner radii of the washer should be.

4. Problem 6.1.11 from the text (you all have access to the electronic version through MyLabsPlus).
   This problem asks about the volume of a tetrahedron. You will need the picture in front of you, otherwise this might not make much sense. Ok, I made a picture, here it is:

   ![Diagram of a tetrahedron](image)

   Notation: The ray from point A to point B is $\overline{AB}$. The line segment from point A to B is $\overline{AB}$. Then length of the line segment from A to B is $AB$.

   To start we will think of $\overline{AD}$ as the $x$-axis, $\overline{AC}$ as the $y$-axis and $\overline{AB}$ as the $z$ axis. Note that $AB = 3$, $AC = 4$ and $AD = 5$. What we are going to do now is find the area of the triangle we get when we slice the tetrahedron parallel to the $xy$-plane. This is denoted by the dashed right triangle, $\triangle EFG$. What we are going to try to do is figure out the area of the dashed triangle based on how high we are on the $z$-axis. Note that $FB = 3 - z$. Now we are going to use trigonometry to find the length of $FG$ and $FE$. 
Recall that if two triangles are similar then the ratios of corresponding sides are the same. In our case triangle $\Delta ACB$ is similar to $\Delta FGB$ so $\frac{4}{3} = \frac{FG}{3-z} \Rightarrow 4(3-z) = FG$. Similarly, $\frac{5(3-z)}{3} = FE$. Now we know the area of the dashed triangle because we know the base and the height so $A_{dashed\Delta} = \frac{1}{2} \cdot \frac{5(3-z)}{3} \cdot \frac{4(3-z)}{3} = \frac{10(3-z)^2}{9}$.

Now imagine that our triangle slice has a little bit of thickness. Our thickness is going to be in the $z$ direction and we will say the thickness is the change in $z$, or $\Delta z$. Then the volume of our little slice is $\frac{10(3-z)^2}{9} \Delta z$.

Here is where the idea of Riemann sums and the definition of the integral from Calculus I come in. Remember how when we first found the area under a curve we chopped the area up into a bunch of rectangles and then added up the areas of the rectangles? Then we used more and more rectangles to get our area more and more accurate. In fact, we ended up using an infinite number of rectangles (which is why we had to study limits) so that we could find the exact area under the curve. We are going to do the same thing with this tetrahedron but instead of areas of rectangles we are going to use volumes of triangular slices. Like in Calc I when we let the width of our rectangles ($\Delta x$) get smaller and smaller we are going to let the thickness of our triangular slices ($\Delta z$) get smaller and smaller. To make $\Delta z$ get smaller we need a limit, $\lim_{n \to \infty} \sum_{k=1}^{n} \frac{10(3-z_k)^2}{9} \frac{3}{n}$, where $\Delta z = \frac{3}{n}$. This turns into the integral

$$\int_{0}^{3} \frac{10(3-z)^2}{9} \, dz.$$

You can take it from here.

5. How do you know when to use the disc, washer or shell method?

There is no set of rules that tells you what to use in a given situation. The answer is you have to do lots of problems; I would do more problems than just MyLabsPlus problems. Doing problems is what develops your intuition for what the solid is going to look like and when using one method is easier than using another.

6. What is the equation that I can use to get the volume of a graph rotated about the $x$-axis.

Again, there is no set of rules that will tell you answer to this question. Depending on what the region in the plane looks like you might be able to use the washer method (the easiest one), you might have to use the disc method or these two methods might not even be applicable and using the shell method might be required.

7. How do you calculate $\int x \sin(x) \, dx$ and $\int \sec^2(x) \tan^2(x) \, dx$.

The first one uses integration by parts which we have not discovered yet. The second one is actually a straightforward $u$-substitution. Of course, choosing $u$ is the tricky part. Let’s try some.

If $u = \sec(x)$ then $du = \sec(x) \tan(x) \, dx \Rightarrow \frac{du}{\sec(x) \tan(x)} = dx$. Substituting and simplifying we get

$$\int \sec^2(x) \tan^2(x) \, dx = \int u \tan(x) \, du.$$ That is bad because we have mixed our variables.

If $u = \tan(x)$ then $du = \sec^2(x) \, dx \Rightarrow \frac{du}{\sec^2(x)} = dx$. Substituting we get

$$\int \sec^2(x) \tan^2(x) \, dx = \int \sec^2(x) \tan^2(x) \frac{du}{\sec^2(x)} = \int u^2 \, du = \frac{u^3}{3} + C = \frac{\tan^3(x)}{3} + C.$$

Notice I did not substitute $u = \tan(x)$ right away. In Calculus I it was advisable to do this substitution right away. In Calculus II waiting to make sure something tricky isn’t going on might be something to consider. If you do this be advised that it is easy to mix/change your variables so be careful.
8. Do you enjoy doing Calculus?

Absolutely. I have not done Calculus II in 12 years so it is fun and challenging.

9. How old is your daughter?

My daughter was born on December 10, 2012.

10. What is your favorite sport?

I like to watch the NBA and the NFL. Although I would say I am a sports fan through and through. I love to see the best teams/people competing against each other no matter what the sport happens to be. I guess in particular I like watching distance running events because I ran Track and Cross Country in college.

11. How do you integrate \( \int \tan^2 \left( \frac{\pi x}{4} \right) dx \)?

First note that \( \frac{d}{dx} \tan(x) = \sec^2(x) \) so \( \int \sec^2(x) dx = \tan(x) \). Then recall that from \( \sin^2(x) + \cos^2(x) = 1 \) we can get \( 1 + \tan^2(x) = \sec^2(x) \Rightarrow \tan^2(x) = \sec^2(x) - 1 \). Now we can roll.

\[
\int \tan^2 \left( \frac{\pi x}{4} \right) dx = \int 1 - \sec^2 \left( \frac{\pi x}{4} \right) dx = \int 1 dx - \int \sec^2 \left( \frac{\pi x}{4} \right) dx.
\]

Clearly \( \int 1 dx = x + C \) and we can use \( u = \frac{\pi x}{4} \) to solve the second integral. The solution is \( x - \frac{4}{\pi} \tan \left( \frac{\pi x}{4} \right) + C \).

12. How do you solve \( V = \pi \int_0^{\pi/2} [\sqrt{2} - \sec(x) \tan(x)]^2 dx \)?

This one is deceptively simple. The first thing you do is actually multiply everything out to get

\[
V = \pi \int_0^{\pi/2} [\sqrt{2} - \sec(x) \tan(x)]^2 dx = \pi \int_0^{\pi/2} 2 - 2\sqrt{2} \sec(x) \tan(x) + \sec^2(x) \tan^2(x) dx =
\]

\[
\pi \left[ 2 \int_0^{\pi/2} 1 dx - 2\sqrt{2} \int_0^{\pi/2} \sec(x) \tan(x) dx + \int_0^{\pi/2} \sec^2(x) \tan^2(x) dx \right].
\]

The first integral is easy. The middle integral requires you to remember that \( \frac{d}{dx} \sec(x) = \sec(x) \tan(x) \) and we did the last integral in problem 7. Note that you must be very careful when splitting up integrals, many people will forget that \( \pi \) is multiplied by each integral.

13. What is an example of an unsolvable integral?

Some wise guy or girl wanted me to integrate \( \int \sin(x^3) dx \). I do not believe there is an exact answer to this question. What I would have to do is maybe convert it into it’s exponential form \( \sin(x) = \frac{e^{ix} - e^{-ix}}{2i} \) or use a power series representation \( \sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots \) to approximate the answer.