Announcements

- Assigned reading for the week sections 6.3, Midterm review, 6.4.
- Homework #3 (125 HW 3ABC, all 3 parts) Due Tonight: Wed., Oct. 19, 11:00pm
- Midterm #1 Thursday, October 20 in your sections
  - Covers all material in sections 4.9, 5.1 - 5.5 and 6.1 - 6.3
  - One 8.5 x 11, 2-sided, handwritten sheet of notes.
  - The only calculator which may be used is the Ti-30x IIS.
  - GIVE EXACT ANSWERS. You will lose points if you do not give the exact answer to a problem and instead provide a decimal approximation
  - Give Exact Answers and show all of your work!
  - Do sample midterms from Math 125 Materials webpage (click on "MIDTERM #1 Achive")
  - Box your final answers

Today

- Volumes of Solids of Revolution (Cylindrical Shells and Summary)
- Midterm Review

Topics to review

- Antiderivatives
- Riemann sums, definite integrals and area
- The fundamental theorem of calculus, parts I and II
- Indefinite integrals,
- Net change theorem
- Techniques of integration:
  - Simplify
  - Substitution rule
- Applications of integration
  - Area between curves (includes graphing functions)
  - Volumes (Washer/Disk/Slicing and Cylindrical Shell methods)
  - Distance traveled vs Displacement: acceleration, velocity and position

Computing Volume using Cylindrical Shells

The volume of the solid obtained by rotating about the y-axis the region under the curve $y = f(x)$ from a to b (with $0 \leq a < b$), is

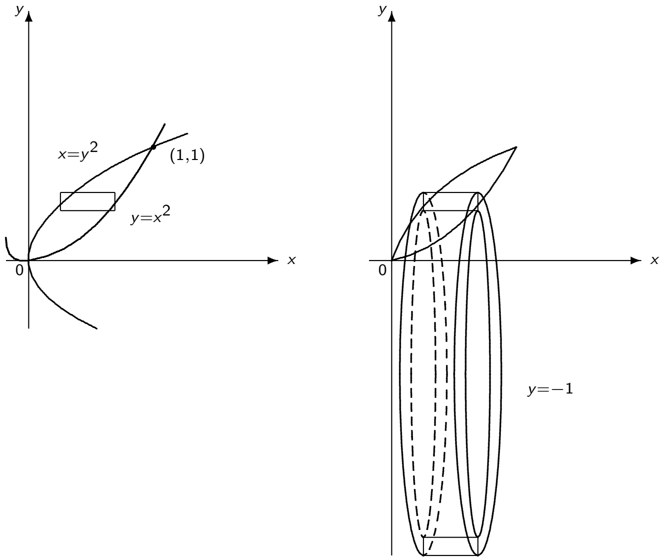
$$V = \int_a^b 2\pi x f(x)\, dx$$

which is geometrically

$$V = \int_a^b 2\pi r(x) h(x)\, dx$$

where $r(x)$ is the radius of the shell and $h(x)$ is it's height. Thus we see that we are integrating the circumference times the height.

Example 4 Find the volume of the solid obtained by rotating the region bounded by $y = x^2$ and $x = y^2$ about $y = -1$.



To compute the volume of a solid S of revolution

1. Sketch the region to be rotated and indicate the axis of revolution
2. Decide which method to use (slices or shells)
3. Determine whether you have an integral with respect to x or with respect to y.
4. Express either the area of the cross section (disk or washer) or the area of the cylindrical shell in terms of the variable of integration.
5. Determine the bounds of integration.
6. Write down the correct definite integral
7. Evaluate the integral to find the volume.

Keep in mind when computing the volume of a *solid of revolution*

• The general principle is that **Volume** is the **Integral of Area**.

• Cross-sections (yielding disks or washers) should be perpendicular to the axis of rotation.

If you rotate with respect to a vertical axis, the cross sections are horizontal and the variable of integration is y. If you rotate with respect to a horizontal axis, the cross sections are vertical and the variable of integration is x.

• The axis of the cylindrical shells coincides with the axis of rotation. The shells have radius the distance to the axis. The typical cylindrical shell is generated by slicing the region parallel to the axis of rotation and rotating the resulting line segment.

If you rotate with respect to a vertical axis, the radius is expressed in terms of x and the variable of integration is x. If you rotate with respect to a horizontal axis, the radius is expressed in terms of y and the variable of integration is y.

Chapter 6, Review problem: Let R be the region in the first quadrant bounded by the curves $y = x^3$ and $y = 2x - x^2$.

(a) Find the volume of the solid obtained by rotating R about the x-axis.

(b) Find the volume of the solid obtained by rotating R about the y-axis.