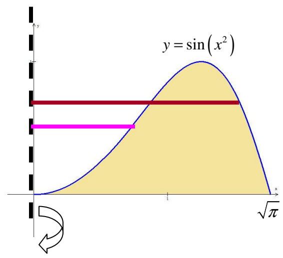
Sometimes finding the volume of a solid of revolution is **impossible** by the disk or washer method



Since there is a gap b/w the region and the axis of rotation, we would try ____________

We would have to solve for __ as a function of __ since the axis of rotation is ________.
Sometimes this is the problem, but we can do it here.

$x =$

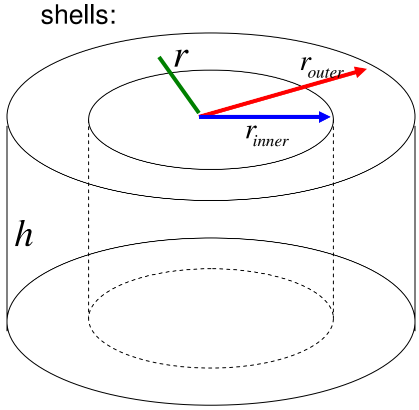
Our problem is that the outer radius and the inner radius use the _________ .

In order to find the volume of this solid of revolution we need a different technique.

Math 104 – Rimmer
6.3 Volumes by Cylindrical Shells

The ____________________ uses the volume of _______ __________ to find the volume of a solid of revolution.

To understand the formula, lets first look at one of the cylindrical shells:



There are two cylinders, an outer cylinder and an inner cylinder.

The volume of the "shell" we use is found by taking the volume of the inner cylinder and ______________the volume of the outer cylinder.

$V_{shell} =$

$V_{shell} =$

$V_{shell} =$

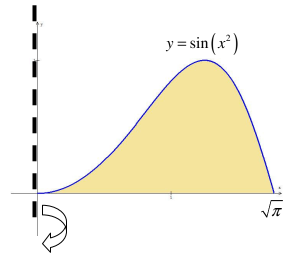
$V_{shell} =$

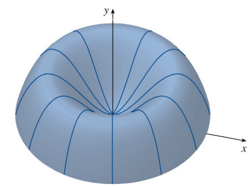
$V_{shell} =$

$$\frac{(r_{outer} + r_{inner})}{2} = r_{average}$$

Let $r = r_{average}$ Let $\Delta r = r_{outer} - r_{inner}$

$V_{shell} =$





$V_{shell} = \underset{\textbf{circumference}}{2\pi r} \cdot \underset{\textbf{height}}{h} \cdot \underset{\textbf{thickness}}{\Delta r}$

$V_i =$

now ______ the volume
of all the shells

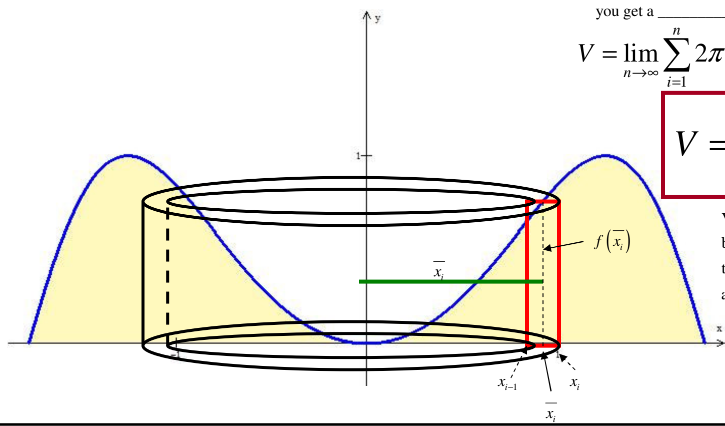
$V =$

you get a __________ as the number of shells ____

$$V = \lim_{n\to\infty} \sum_{i=1}^{n} 2\pi\left(\overline{x_i}\right)\cdot f\left(\overline{x_i}\right)\cdot \Delta x$$

$V =$

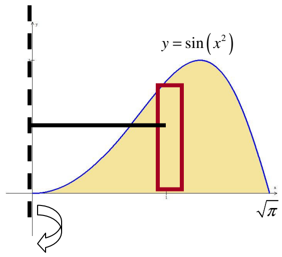
Volume of the solid obtained
by rotating the region under
the curve $f(x)$ from $x = a$ to $x = b$
about the $y-axis$



In general,

$$V = \int_a^b 2\pi(\text{radius})(\text{height})\ dx$$

	Typical rectangle	Vertical axis of rotation	Horizontal axis of rotation
Disk or Washer			
Cylindrical Shells			



radius =

height =

$$V = \int_a^b 2\pi\left(\text{radius}\right)\left(\text{height}\right)dx$$

$V =$

$=$

$=$

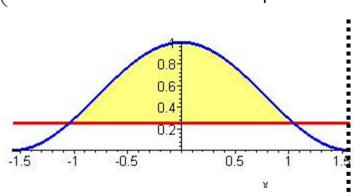
$=$

$=$

Set up, but do not evaluate, an integral for the volume obtained by rotating the region bounded by

$y = \cos^2 x,\ \ y = \dfrac{1}{4},$ about the line $x = \dfrac{\pi}{2}$

$\left(\text{below } y = \cos^2 x \text{ and above } y = \dfrac{1}{4}, \text{from } -a \text{ to } a \text{ where these are the intersection pts. closest to the } y\text{-axis}\right)$



radius =

height =

limits of integration $\Rightarrow$

$$V = \int_a^b 2\pi\left(\text{radius}\right)\left(\text{height}\right)dx$$