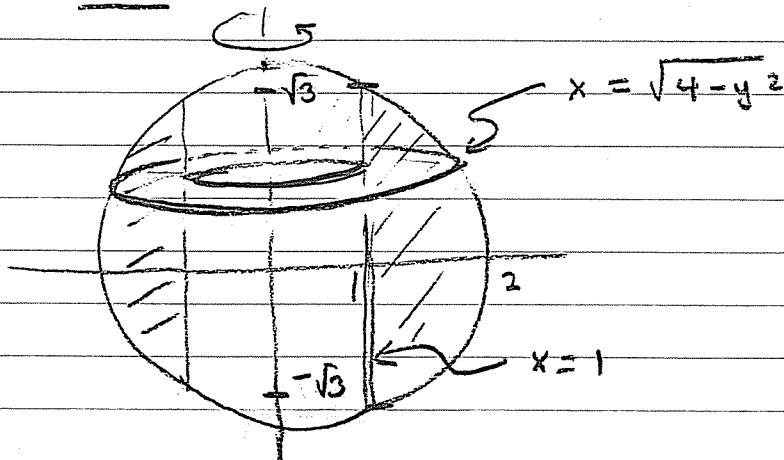


A "bead" is formed by removing a cylinder of radius  $r$  from the center of a sphere of radius  $R$ . Find the volume of the bead with  $r=1$ ,  $R=2$ .

Solution: The bead is a solid of revolution.



The area of the cross-section is

$$A(y) = \pi \left[ (\sqrt{4-y^2})^2 - 1^2 \right]$$

$$= \pi (3-y^2)$$

We integrate between  $y = -\sqrt{3}$  and  $y = \sqrt{3}$ .

(Why? Let  $x=1$  in the equation  $x = \sqrt{4-y^2}$ )

$$\text{Volume} = \int_{-\sqrt{3}}^{\sqrt{3}} \pi (3-y^2) dy = 4\pi\sqrt{3}$$