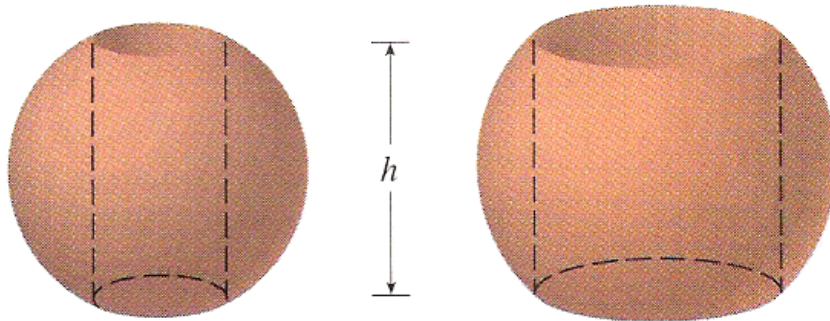


## 1. Napkin Ring Problem

At some fancy dinners, elegant hosts might use a *napkin ring* to keep a napkin rolled rolled like this:



Suppose you make napkin rings by drilling holes with different diameters through two wooden balls (which also have different diameters).



You discover that both napkin rings have the same height  $h$ , as shown in the figure.

- Guess which ring has more wood in it.
- Check your guess: Use cylindrical shells to find a formula for the volume of a napkin ring created by drilling a hole through the center of a sphere of radius  $R$  leaving a height,  $h$ . Express your equation for  $V$  in terms of  $R$  and  $h$ .

2. Refer to the figure and consider the volume generated by rotating the given region about the specified line. For each subproblem below,

(i) Use the diagram to setup a washer *volume element* ( $dV$ ). Be sure to sketch an area element on region  $S$  and the graph of the given line.

(ii) Set up (*but do not evaluate*) an integral to compute the volume of the solid obtained by rotating region  $S$  about the given line.

(a)  $\mathcal{R}_1$  about  $\overline{OA}$

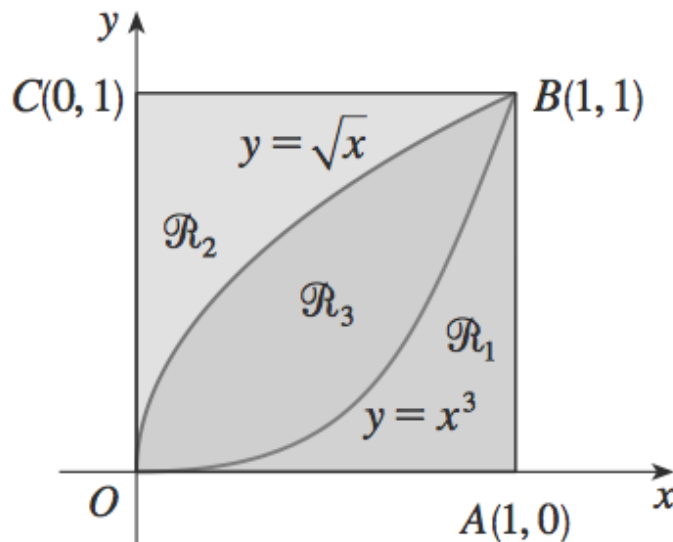
(b)  $\mathcal{R}_1$  about  $\overline{AB}$

(c)  $\mathcal{R}_2$  about  $\overline{OA}$

(d)  $\mathcal{R}_2$  about  $\overline{AB}$

(e)  $\mathcal{R}_3$  about  $\overline{OA}$

(f)  $\mathcal{R}_3$  about  $\overline{AB}$



3. Repeat the previous question using cylindrical shells.