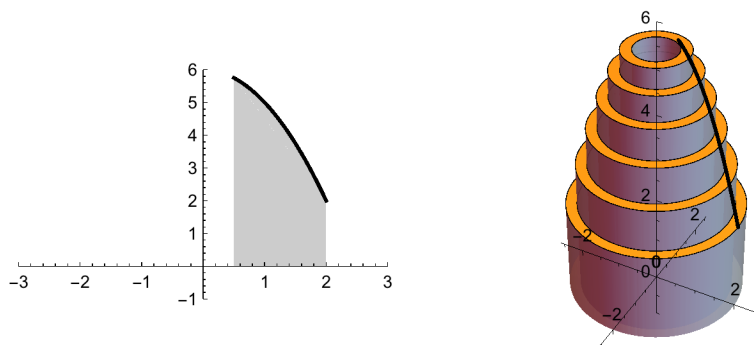


## 6.3 Volumes by Cylindrical Shells

The solid obtained by revolving the area under the function  $f$  on  $[a, b]$  about the  $y$ -axis is given by

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

**Example 1** Find the volume of the solid bounded by  $y = 6 - x^2$  and the  $x$ -axis on the interval  $[0.5, 2]$  rotated about the  $y$ -axis.



**Example 2** A hole of radius 1 inch is drilled through the center of a wooden sphere with diameter of 6 inches. How much wood is removed; how much wood is remaining?

**Example 3** The region bounded by  $f(x) = e^x$  on the interval  $[0, 2]$  is revolved about the line  $x = 3$ . Use an appropriate method to calculate the resulting volume.

**Example 4** Find the volume of the solid bounded by  $y = \sqrt{x} + 2$ ,  $y = x - 3$ ,  $x = 1$ , and  $x = 4$ , revolved about the line  $x = 5$ .