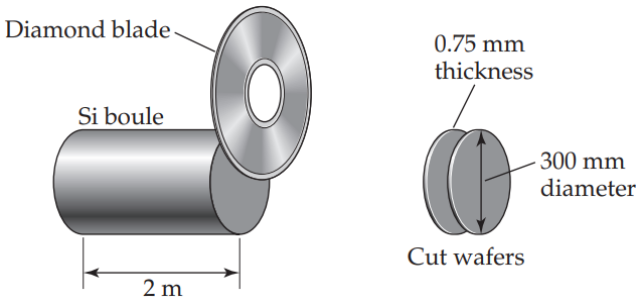
Exercise 1.40

Silicon for computer chips is grown in large cylinders called "boules" that are 300 mm in diameter and 2 m in length, as shown. The density of silicon is 2.33 g/cm^3. Silicon wafers for making integrated circuits are sliced from a 2.0-m boule and are typically 0.75 mm thick and 300 mm in diameter. (**a**) How many wafers can be cut from a single boule? (**b**) What is the mass of a silicon wafer? (The volume of a cylinder is given by $\pi r^2 h$, where r is the radius and h is its height.)



Solution

Part (a)

Find how many times 0.75 mm goes into 2 m—this is the number of wafers that can be made from a single boule.

$$\#\text{ of wafers} = \frac{2\ \frac{\cancel{\text{meters}}}{\text{boule}}}{0.75\ \frac{\cancel{\text{mm}}}{\text{wafer}} \times \frac{1\ \cancel{\text{m}}}{1000\ \cancel{\text{mm}}}} \approx 3 \times 10^3\ \frac{\text{wafers}}{\text{boule}}.$$

Part (b)

The mass of a silicon wafer is

$$\begin{aligned}\text{mass} &= \text{density} \times \text{volume} \\ &= 2.33\ \frac{\text{g}}{\cancel{\text{cm}}^3} \times \left(\frac{1\ \cancel{\text{cm}}}{10\ \text{mm}}\right)^3 \pi \left(\frac{300\ \text{mm}}{2}\right)^2 (0.75\ \text{mm}) \\ &\approx 1 \times 10^2\ \text{g}.\end{aligned}$$