

Problem 10

(III) What, roughly, is the percent uncertainty in the volume of a spherical beach ball whose radius is $r = 0.84 \pm 0.04$ m?

Solution

The volume of a sphere is given by

$$V = \frac{4}{3}\pi r^3.$$

Calculate it with the lowest value of r and the highest value of r .

$$r = 0.80 : V = \frac{4}{3}\pi(0.80 \text{ m})^3 \approx 2.1 \text{ m}^3$$

$$r = 0.88 : V = \frac{4}{3}\pi(0.88 \text{ m})^3 \approx 2.9 \text{ m}^3$$

As a result, the volume is $V = 2.5 \pm 0.4 \text{ m}^3$. The percent uncertainty is then

$$\begin{aligned}\text{Percent Uncertainty} &= \frac{\Delta V}{V} \times 100\% \\ &= \frac{0.4}{2.5} \times 100\% \\ &= 16\%.\end{aligned}$$