

## Problem 84

The sides of a small rectangular box are measured to be  $1.80 \pm 0.1$  cm,  $2.05 \pm 0.02$  cm, and  $3.1 \pm 0.1$  cm long. Calculate its volume and uncertainty in cubic centimeters.

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### Solution

Calculate the maximum volume by multiplying the upper bounds for length, width, and height.

$$\text{Maximum Volume: } (1.80 + 0.1 \text{ cm})(2.05 + 0.02 \text{ cm})(3.1 + 0.1 \text{ cm}) \approx 13 \text{ cm}^3$$

Calculate the minimum volume by multiplying the lower bounds for length, width, and height.

$$\text{Minimum Volume: } (1.80 - 0.1 \text{ cm})(2.05 - 0.02 \text{ cm})(3.1 - 0.1 \text{ cm}) \approx 10 \text{ cm}^3$$

The volume and uncertainty is therefore roughly

$$\left( \frac{13 + 10}{2} \pm \frac{13 - 10}{2} \right) \text{ cm}^3$$
$$(11 \pm 1.1) \text{ cm}^3.$$