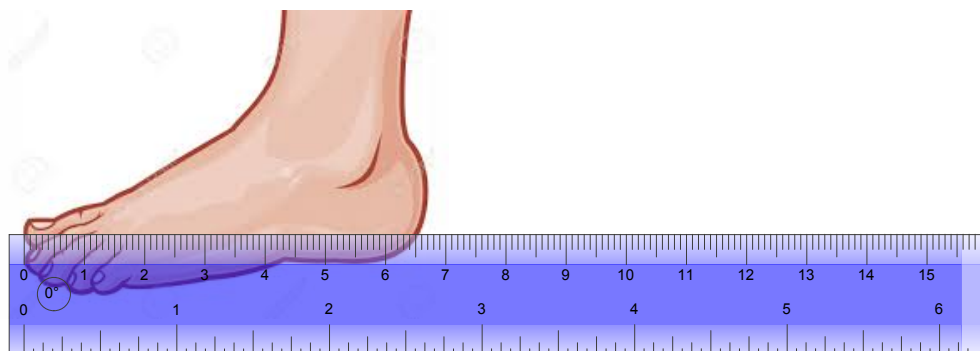


UNCERTAINTY

How long is this foot?



$$6.65 \pm 0.05$$

smallest: 6.60

largest: 6.70

How far off do you think this measurement might be?

Any measurement includes some uncertainty. This uncertainty is a result of the instruments used to make the measurement.

$$\text{uncertainty} = \pm \frac{(\text{biggest measure} - \text{smallest measure})}{2}$$

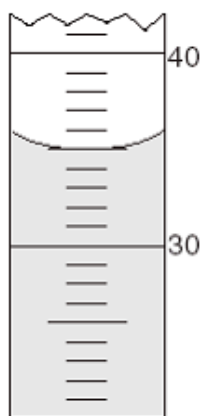
for electronic readings = $\pm \frac{1}{2}$ smallest units place

Stating the uncertainty of a value is essential in lab experiments.

The uncertainty can be recorded in two ways:

1. Absolute uncertainty recorded with the same units of measure
2. Relative uncertainty expressed as a percent of recorded value

Ex: Determine the volume of liquid in a 100-mL graduated cylinder.



35.0 mL \pm 0.1 mL absolute uncertainty

relative:

$$\frac{0.1}{35.0} \times 100\% = 0.3\%$$

35.0 mL \pm 0.3%

Determine the perimeter and area of the box.



$$\text{width} = 2.20 \pm 0.05 \text{ cm}$$

$$\text{length} = 3.15 \pm 0.05 \text{ cm}$$

$$P = 2(l+w)$$

$$= 10.70 \pm 0.20 \text{ cm}$$

for perimeter the uncertainty
is added 4 times

$$A = l \cdot w$$

$$= 6.93 \text{ cm}^2 \pm 4\%$$

for area we need to use
relative uncertainty:

$$\frac{0.05}{3.15} \times 100\% = 1.58\% = 2\%$$

$$6.93 (0.04)$$

$$= 0.2772$$

$$= 0.3$$

$$\frac{0.05}{2.20} \times 100\% = 2.27\% = 2\%$$

$$2\% + 2\% = 4\%$$

$$\text{Area} = \underline{6.93} \pm \underline{0.3} \text{ cm}^2$$

this disagreement
exists from sig figs rule

When adding/subtracting measurements the absolute uncertainties are added.

When any performing other operations the relative uncertainties are added.