

Combining Uncertainties

Since every measurement has uncertainty, if you add together 2 measurements you must also add their uncertainties.

Example 5

A string that is 10.3 cm long is placed beside another string that is 5 cm long. Find the total length of both strings, including uncertainty.

① Calculate the uncertainty of each of the given measurement.

$$10.3 \text{ cm} \rightarrow \text{the precision is } 0.1 \text{ cm}$$

$$\text{Uncertainty} = \frac{0.1 \text{ cm}}{2} \Rightarrow \underline{0.05 \text{ cm}}$$

$$5 \text{ cm} \rightarrow \text{Precision} = 1 \text{ cm}$$

$$\text{Uncertainty} = \frac{1 \text{ cm}}{2} \Rightarrow \underline{0.5 \text{ cm}}$$

② Add the two measurements: $10.3 + 5 = 15.3 \text{ cm}$

Example 6 add uncertainties $= 0.05 + 0.5 = 0.55 \text{ cm}$

TOTAL Length $= 15.3 \pm 0.55 \text{ cm}$

You are building a wooden pathway for your garden and you cut three pieces of board. One piece is 2.09 metres, the second piece is 2.1 metres, and the third is 1.99 metres. Determine the total length of all three boards, including uncertainty.

Piece 1 (2.09 m)

$$\text{Precision} = 0.01 \text{ m}$$

$$\text{Uncertainty} = \frac{0.01 \text{ m}}{2} = \underline{0.005 \text{ m}}$$

Piece 2 (2.1 m)

$$\text{Precision} = 0.1 \text{ cm}$$

$$\text{Uncertainty} = \frac{0.1 \text{ cm}}{2} = \underline{0.05 \text{ m}}$$

Piece 3 (1.99 m)

$$\text{Precision} = 0.01 \text{ m}$$

$$\text{Uncertainty} = \frac{0.01 \text{ m}}{2} = \underline{0.005 \text{ m}}$$

TOTAL

$$\text{Piece 1} = 2.09 \pm 0.005 \text{ m}$$

$$\text{Piece 2} = 2.1 \pm 0.05 \text{ m}$$

$$\text{Piece 3} = 1.99 \pm 0.005 \text{ m}$$

$$\text{FINAL} \rightarrow \underline{6.18 \pm 0.06 \text{ m}}$$

