

EM40S

Lesson 2

Uncertainty

**Uncertainty**

**Uncertainty** - the margin of error of the measurement, usually half the precision of the device.

**Example 1** precision  $\div 2$ 

A nurse measures a patient's temperature to be  $37^{\circ}\text{C}$ .

State each of the following:

- a) the precision:  $1^{\circ}\text{C}$  (or nearest degree)  
 $\div 2$
- b) the uncertainty:  $0.5^{\circ}\text{C}$
- c) the maximum temperature:  $37^{\circ}\text{C} + 0.5^{\circ}\text{C} = 37.5^{\circ}\text{C}$   
 add uncertainty
- d) the minimum temperature:  $37^{\circ}\text{C} - 0.5^{\circ}\text{C} = 36.5^{\circ}\text{C}$   
 subtract uncertainty

**Example 2**

A person's height is measured at  $5'9''$ .

State each of the following:

- a) the precision:  $1''$
- b) the uncertainty:  $0.5''$  ( $\div 2$ )  
 or  $\frac{1}{2}''$
- c) the maximum height:  $5'9'' + \frac{1}{2}'' = 5'9\frac{1}{2}''$
- d) the minimum height:  $5'9'' - \frac{1}{2}'' = 5'8\frac{1}{2}''$

**Example 3 - Your turn!!!**

State the uncertainty for each of the following:

a) a metre stick that is precise to 1mm

$0.5 \text{ mm}$

b) a bathroom scale that is precise to 0.5 kg

$0.25 \text{ kg}$

**Example 4 - Combining Measurements I**

A farmer is combining 1 L of fertilizer with 1 L of water. The measuring device he uses is precise to 0.1 L

a) What is the uncertainty of the measuring device?

$0.05 \text{ L}$

*uncertainty of device*

b) If the farmer combines the fertilizer and water, what is the final value, including the uncertainty?

$$\begin{array}{l}
 \text{Fertilizer : } 1 \text{ L} \pm 0.05 \text{ L} \\
 \text{Water : } 1 \text{ L} \pm 0.05 \text{ L} \\
 \hline
 2 \text{ L} \pm 0.10 \text{ L}
 \end{array}$$

*ⓐ Add amounts  
ⓑ Add uncertainties*

**Example 5 - Combining Measurements II**

A grocer combines boxes of vegetables with weights of 16.5 kg, 2.8 kg, and 1.4 kg.

a) What is the precision of each measurement? What is the uncertainty?

$0.1 \text{ kg}$

$0.1 \text{ kg} \div 2 = 0.05 \text{ kg}$

b) What is the combined weight of the boxes, including the uncertainty?

$$\begin{array}{l}
 16.5 \text{ kg} \pm 0.05 \text{ kg} \\
 2.8 \text{ kg} \pm 0.05 \text{ kg} \\
 1.4 \text{ kg} \pm 0.05 \text{ kg} \\
 \hline
 20.7 \text{ kg} \pm 0.15 \text{ kg}
 \end{array}$$

$(20.7 \pm 0.15) \text{ kg}$

c) Calculate the difference between the 16.5 kg and 1.4 kg measurements, including the uncertainty.

$$\begin{array}{r}
 16.5 \text{ kg} \pm 0.05 \text{ kg} \\
 - 1.4 \text{ kg} \pm 0.05 \text{ kg} \\
 \hline
 15.1 \text{ kg} \pm 0.10 \text{ kg}
 \end{array}$$

$(15.1 \pm 0.10) \text{ kg}$

Precision Measurement

*Hi Justin*