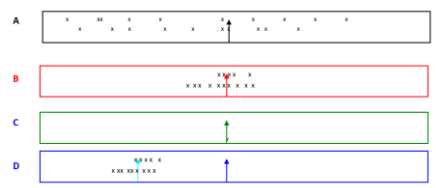
Uncertainties & Prefixes



systematic uncertainties can arise due to measurement techniques or experimental design. When readings taken are either all too small or all too large, they offset the mean value.

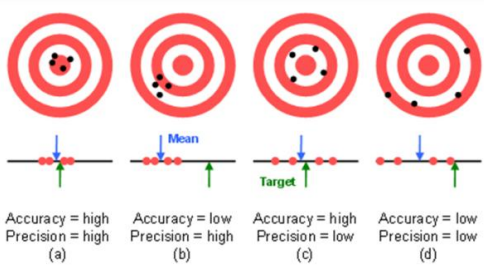
Tera	$x10^{12}$
Giga	$x10^{9}$
Mega	$x10^{6}$
kilo	$x10^{3}$
milli	$x10^{-3}$
μ micro	$x10^{-6}$
nano	$x10^{-9}$
pico	$x10^{-12}$

$$\Delta R = \frac{R_{max} - R_{min}}{n}$$

Units are same as your measurement

Accuracy is how close you are to the actual value (on the dot)

Precision repeatability



QUANTIFYING UNCERTAINTIES

FIND THE MEAN

$$\text{mean value} = \frac{\Sigma \text{results}}{\text{no. of observation}}$$

Your mean must be to the same sig fig as your measurements! This is the best estimate of the "true" value but not necessary the "true" value

FIND THE APPROXIMATE RANDOM UNCERTAINTY IN THE MEAN (ABSOLUTE UNCERTAINTY)

$$\text{approximate random uncertainty in mean} = \frac{\max value - \min value}{\text{no. of observation}}$$

$$\Delta R = \frac{R_{max} - R_{min}}{n}$$

This can be written as $= \frac{\text{range}}{\text{no. of observation}}$ and it is sometimes referred to as *average deviation or absolute uncertainty*.

stop here and quote the result with an approx. random uncertainty

MEAN ± approx. random uncertainty (UNITS)

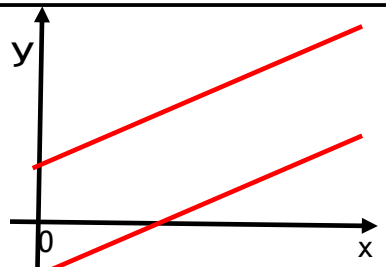
FIND THE PERCENTAGE UNCERTAINTY.

$$\text{percentage uncertainty} = \frac{\text{approx. random uncertainty}}{\text{mean value}} \times 100\%$$

$$\text{percentage uncertainty} = \frac{\frac{\text{range}}{n}}{\text{mean value}} \times 100\%$$

stop here and quote the result with a percentage uncertainty

MEAN (UNITS) ± percentage uncertainty (%)



A systematic effect can often be seen if the points are close to the line, but the line is offset from (0,0) when it should start at the origin.

- Quantify the prefixes
- State appropriate relationship to quantify random uncertainties
- State the effect of systematic uncertainties and how they arise
- Graphically how does a systematic uncertainty often show up.
- Explain accuracy & Precision
- Give an example of how to quantify uncertainties
- State what can often be used as a good estimate of the percentage uncertainty in the final numerical result of an experiment
- The largest uncertainty is any one measurement is the best estimate of your overall uncertainty.
- State what the mean of a set of repeated measurement represents
- State the relationship to determine the mean
- $\frac{\Sigma x}{n}$ don't forget units
- identify quantities liable to uncertainty
- State the cause of random uncertainties
- Define a scale reading uncertainty
- State how random uncertainties can be reduced.
- State the scale reading uncertainty in an analogue and digital device
- the mean of a set of repeated measurements is the best estimate of the 'true' value of the quantity being measured

all measurements of physical quantities are liable to uncertainty

arise when an experiment is repeated and slight variations occur

is an indication of how precisely (well) a scale can be read.

Repeat and find an mean average.

Analogue ± half the smallest division.

Digital ± the value of the smallest division, e.g MrsPhysics's scales read to 0.2 kg therefore her mass is 63.0 ± 0.2 kg or 63.0 kg ± 0.3% (1 sig fig)

% uncertainty = uncertainty/mean x 100%

QUANTIFYING UNCERTAINTIES

FIND THE MEAN

$$\text{mean value} = \frac{\Sigma \text{results}}{\text{no. of observation}}$$

Your mean must be to the same sig fig as your measurements! This is the best estimate of the "true" value but not necessary the "true" value

FIND THE APPROXIMATE RANDOM UNCERTAINTY IN THE MEAN (ABSOLUTE UNCERTAINTY)

$$\text{approximate random uncertainty in mean} = \frac{\max value - \min value}{\text{no. of observation}}$$

$$\Delta R = \frac{R_{max} - R_{min}}{n}$$

This can be written as $= \frac{\text{range}}{\text{no. of observation}}$ **and it is sometimes referred to as *average deviation or absolute uncertainty.***

stop here and quote the result with an approx. random uncertainty

MEAN±approx. random uncertainty (UNITS)

FIND THE PERCENTAGE UNCERTAINTY.

$$\text{percentage uncertainty} = \frac{\text{approx. random uncertainty}}{\text{mean value}} \times 100\%$$

$$\text{percentage uncertainty} = \frac{\frac{\text{range}}{n}}{\text{mean value}} \times 100\%$$

stop here and quote the result with a percentage uncertainty

MEAN (UNITS)± percentage uncertainty (%)