# Methods

## Criticizing & Opinions

### Criticizing data

Point out inconsistent features that otherwise would be done in an experiment, such as:

1. Same significant figure
2. Continuous increment
3. Large range of values
4. Large sets of results (>5)
5. Sign of repeat to find mean (No sign / only mean values are common things to criticize)
6. Units in header

### Discuss whether graph supports suggested equation / test relationship

1. Rearrange & compare equation to
2. Identify gradient
   1. Calculate gradient from graph and compare

## Measurement

### Measuring devices

Long / short stationary length: Meter rule () / digital calipers () / micrometer ()

### Common questions

**Conducting measurements**

* Graphical method: Measure variable using measuring devices

Repeat for same value and calculate mean

Repeat for at least 5 sets of results

Keep other variables constant

Plot graph to check straight line

* Accurate oscillation msumt.: Measure multiple oscillations, divide by n *reduce %U*

*First 2 points for reading oscilloscopes* Repeat mean *reduce random error*

Use timing marker at center

Start timing after a few rotations

* Accurate perpendicular dist. msumt.: Meter rule + set square

Read value perpendicularly *reduce parallax error*

* Accurate length msumt. techniques: Check for zero error *reduce systematic error*

Repeat at different positions to find mean *reduce random error*

* Accurate temp. msumt.: Place thermometer close to source

Stir water

**Measuring accuracy**

* Why light gate: Remove reaction time

Remove parallax error as in fixed position

* Why data logger: Many readings can be taken simultaneously in a short time
* Why motion camera: Helps with judging time when rotation is completed

Helps with viewing motion slowly

**Uncertainty**

* Why reduce % uncertainty: Uncertainty in measuring device constant, larger measurement 🡪 lower %U
* Why the uncertainty in … is …: Uncertainty of single measurement is half the resolution of measuring device

U% = U1% \* n

* Determine %U in value of …: *For squared variables %U \* 2*
* Determine whether value accurate: *Find %U upper lower boundary, value lies in range → accurate*

### Common errors & techniques

|  |  |
| --- | --- |
| *Error* | *Solution* |
| **Systematic** (e.g. Zero error) | Zero balance before measurement |
| **Parallax** | Ensure measuring device is at eye-level |
| **Random** | Repeat and calculate mean value |

## Measuring device operation

|  |  |
| --- | --- |
|  |  |
| *Reading vernier calipers: 3.34cm* | *Reading micrometer: 17.9mm* |

## Changing variables

### Determining value from graph

Use a large triangle to determine gradient

### Completing tables

Use same significant figures

# Experiments

## Emission of radiation investigations

### Setup

1. Measure background count
2. Ensure source and detector in line
3. Measure d with meter rule
4. Repeat measure count then find mean
5. Subtract background rate
6. Plot graph

### Precaution

1. Handle source with long tongs
2. Maintain distance from source when use

### Common questions

* Why measure background count: Subtract from measured count as systematic error

## Capacitor investigations

### Setup

1. Capacitor connected to power supply
2. Circuit to discharge capacitor through A & R
3. Switch

### Precaution

* Ensure capacitor fully discharged

### Determine capacitance

1. Choose the value of resistor to give a reasonable discharge time
2. Measure the resistance of the resistor using a multimeter
3. Charge the capacitors to the initial p.d.
4. Start the stopwatch at the same time as changing the switch
5. Plot I-t graph, find time for I to fall to 37%

## Specific latent heat investigations

### Setup

1. Power supply, joulemeter

### Determine L

1. Wait until water boils
2. Record values of m to E with joulemeter
3. Plot m-E graph
4. Gradient is

### Source of errors

1. Water moving
2. Heat lost to surroundings