# 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

### Safety of use of material, given property

Interpret meaning of property, then find value of property in which might pose a threat to safety

### Why graph should be a straight line, given equation

1. Rearrange & compare equation to
2. Identify gradient and y-intercept
3. If straight line mentioned, show gradient is constant

## Measurement

### Calculating mean

Identify & exclude anomalies not within and take mean value

### Measuring devices

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

Distance between movements: Video camera and suitable length measuring device for same position on object

Temperature: Thermometer (if water bath, then measure temperature of water)

Mass: Balance

Volume: Measuring cylinder

Time: Stop watch / light gates

Voltage: Voltmeter parallel to electrical component

Current: Ammeter in series

Angle: Protractor

Right angle: Against set square

### Measuring methods

Radius: Measure diameter then divide by 2

Density: Measure mass and volume, then divide

Acceleration: Measure distance travelled, time taken,

### Determining value

1. Device
2. Measure for > 5 set results
3. Formula
4. Repeat Mean
5. check no systematic error

### Common questions

**Conducting measurements**

* Why is measuring device suitable: Much less resolution compared to measurement, low % uncertainty
* Accurate length measurement: Measuring device

Readings in different positions (as object might not be uniform, mention if explain)

Ensure measurement at widest point

Take mean

Reduce systematic error

* Why digital measuring device: Less % uncertainty, higher resolution, no parallax error

**Measuring accuracy**

* Why reduce % uncertainty: uncertainty in measuring device constant, larger measurement 🡪 lower % uncertainty

Device has lower resolution

* Why accurate: Low % difference between value and constant value
* Which is greater source of uncertainty: Calculate all uncertainties and compare

### Common uncertainties

|  |  |  |
| --- | --- | --- |
| *Uncertainty* | *Causes* | *Solution* |
| Zero error | ~Mass | Zero balance before measurement *or*  Subtract y-var with value of error |
| Parallax error | ~Length | Ensure measuring device is at eye-level |
| Uncertain position | \* | Repeat and calculate mean value |
| Non-monochromatic light | Range of wavelengths | Use monochromatic light |
| Extrapolated data point | \* | Take measurements at regions around data point |

## Measuring device operation

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

### Using light gates to determine velocity

1. Measure length of moving object

## Changing variables

* Temperature of electrical comp: Water bath, Bunsen burner to increase, add ice to decrease temperature
* Potential difference on electrical comp: Variable resistor in series

### Finding point at which variable stops behaving normally

1. Keep finding more values
2. Identify point at which graph curves
3. Take smaller increments

### Determining value from graph

Use a large triangle to determine gradient

### Completing tables

Same s.f.

# Experiments

# Mathematical methods

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| --- | --- |
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