CIE Physics A Level

2 - Measurement Techniques

Flashcards

What is accuracy?

What is accuracy?

- Accuracy is a measure of how close a measured value is to the true, accepted value.
- If a experiment result is accurate it is very close to the true value.
- In practice, the true value usually is not known.

What is a random error?

What is a random error?

An error that occurs due to unexpected changes during an experiment. These cannot be predicted and they can cause repeated results to differ from one another.

What is an anomaly?

What is an anomaly?

An anomaly (also known as an outlier) is a data point or a value in a set of results that does not fit the trend of the data and is therefore an unexpected result. These can happen as a result of random errors during an experiment.

What is a systematic error?

What is a systematic error?

An error that occurs due to faults in equipment or experimental method. Systematic errors cause the result to differ by the same amount each time, making them predictable. They can occur due to not calibrating an instrument correctly.

State three ways of reducing random errors.

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1. Take at least three repeats and calculate a mean -t his increases the likelihood of identifying anomalies.
2. Use computers/data loggers.
3. Use higher resolution equipment.

A mass balance reads 1004 g when a 1kg mass is placed on it. Is this a random or systematic error?

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Systematic, as the reading is too high by 4g each time.

How can systematic error be reduced?

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Calibrate apparatus before using e.g. zero the balance when it is empty.

Is electronic noise in the circuit of an ammeter random error or systematic error?

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Random error, as it will cause fluctuations in readings that affect precision and it cannot be removed.

Why should you measure background radiation before measuring the radioactivity of a source?

Why should you measure background radiation before measuring the radioactivity of a source?

So that only the source's radioactivity is measured. By accounting for background radiation, systematic error can be reduced.

What is precision?

What is precision?

How consistent/close together repeat readings are. The closer they are, the more precise they are.

What is meant by resolution?

What is meant by resolution?

The smallest change in the quantity being measured that gives a recognisable change in reading. (E.g. on a ruler, the resolution is 1mm)

What is absolute uncertainty?

What is absolute uncertainty?

Uncertainty given as a fixed quantity.

E.g. 7 ± 0.6 V

What is the percentage uncertainty in 17 ± 3 A ?

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$$3/17 \times 100 = 17.647\ \%$$

$$\approx 18\ \%\ (2\ \text{s.f.})$$

What is the fractional uncertainty in 8 ± 0.5 m?

What is the fractional uncertainty in 8 ± 0.5 m?

$$0.5/8 = 1/16$$

How can percentage and fractional uncertainty be reduced?

How can percentage and fractional uncertainty be reduced?

Measure larger quantities. For example, a longer rope will have a smaller percentage uncertainty than a shorter one.

The time for 10 swings of a pendulum is 13 ± 0.3 s. What is the time and uncertainty for one swing?

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What is the time and uncertainty for one swing?

1 swing = 13/10 = 1.3s

Uncertainty = 0.3/10 = 0.03 s

Time = 1.3 ± 0.03 s

What is the difference between a reading and a measurement?

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Readings are when one value is found, measurements are when the difference between two readings is found.

What is the uncertainty of a thermometer whose smallest division is 5ºC?

What is the uncertainty of a thermometer whose smallest division is 5ºC?

The uncertainty in a reading is ± half the smallest division, so the uncertainty is ± 5/2 or ±2.5 ºC.

What is the percentage uncertainty in the measurement of a 2cm line?

What is the percentage uncertainty in the measurement of a 2cm line?

Each end has uncertainty ±0.5mm, and 0.5 + 0.5 = 1, so the absolute uncertainty = ±1mm

% uncertainty = 1/20 x 100 = 5% (2cm is 20mm)

What is the uncertainty in the charge of an electron (1.6×10^{-19}C)?

What is the uncertainty in the charge of an electron (1.6×10^{-19} C)?

The uncertainty in a given value is ± the last significant digit:

$= 1.6 \times 10^{-19} \pm 0.1 \times 10^{-19}$ C

The times for a ball to drop are measured as 3.2s, 3.6s and 3.1s. Find the mean and absolute uncertainty of these times.

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Mean : (3.2 + 3.6 + 3.1) / 3 = 3.3 s

Uncertainty = half the range (3.6 - 3.1) / 2 = 0.25 (≈ 0.3 to 1 s.f.)

3.3 ± 0.3s

What is wrong with writing 7 ± 0.673 V?

What is wrong with writing 7 ± 0.673 V?

The uncertainty should be the same number of significant figures as the data ie. 7 ± 0.7 V.

A thermometer with an uncertainty of 0.5 K shows the temperature of water falling from 298 ± 0.5 K to 273 ± 0.5K. What is the difference in temperature and the uncertainty in this difference?

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298 - 273 = 25K 0.5 + 0.5 = 1K

(when adding or subtracting data, add the absolute uncertainties)

Difference = 25 ± 1 K

A force of 91 ± 3 N is applied to a mass of 7 ± 0.2 kg. What is the acceleration of the mass?

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When multiplying/dividing data add percentage uncertainties

$$a = F / m = 91 / 7 = 13 \text{ m s}^{-2}$$

$$\% \text{ uncertainty} = ((0.2 / 7) \times 100) + ((3 / 91) \times 100)$$

$$= 6.2\%$$

$$a = 13 \pm 6.2\%$$

What is 9.71×10^{-21} to the nearest order of magnitude?

What is 9.71×10^{-21} to the nearest order of magnitude?

It is 1×10^{-20} to 1s.f.

So the nearest order of magnitude is 10^{-20}.

What is the difference between independent and dependent variables?

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- Independent variables are what you change in an investigation. Dependent variables are what is observed or measured.
- Independent variables are normally the cause of the effect on the dependent variables.

What are control variables?

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Control variables are any other quantities that could change the value of the dependent variable and need to be kept constant during the experiment.

State 3 instruments used to measure length.

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1. Ruler.
2. Caliper.
3. Micrometer.

How can the weight of an object be found from its mass reading on the mass balance?

How can the weight of an object be found from its mass reading on the mass balance?

Weight = mass x 9.81

9.81 is the value of the gravitational field strength (g) at the Earth's surface.

What is a galvanometer used to measure?

What is a galvanometer used to measure?

Current, they have a needle that moves in an arc along a scale depending on the magnitude of the current.

What can be measured with a cathode ray oscilloscope?

What can be measured with a cathode ray oscilloscope?

The frequency, time period and amplitude of an electronic signal and also whether it is alternating or direct.

What is a calibrated hall probe used for?

What is a calibrated hall probe used for?

To measure the magnitude of a magnetic field.

How can a calibration curve be created and used?

How can a calibration curve be created and used?

Plot the curve for known values e.g. a concentration of 5molm^{-3} gives an absorption of 45 au and then draw a line of best fit, when you have an unknown value simply find where it would fit on the curve and read it off at that point.