OCR Physics A Level

2 - Foundations of Physics

Flashcards

What are SI units?

What are SI units?

Fundamental (base) units of physical quantities.

What is the SI unit of mass?

What is the SI unit of mass?

Kilogram - kg.

What physical quantity is measured in mol?

What physical quantity is measured in mol?

Amount of substance.

What is the SI unit of current?

What is the SI unit of current?

Amperes (A).

Is the SI unit for temperature ºC or K ?

Is the SI unit for temperature °C or K ?

K (kelvin) as this is the absolute scale.

What is the SI unit of length?

What is the SI unit of length?

Metres - m.

What quantity is measured in seconds?

What quantity is measured in seconds?

Time.

Are Newtons (N) an SI unit?

Are Newtons (N) an SI unit?

No, Newtons are not fundamental, the SI units for force are kg m s^{-2} (since F = ma).

Derive the SI units of energy.

Derive the SI units of energy.

Kinetic energy = ½ x mass x velocity^2

Units = kg x $(m/s)^2$ = kg m^2 s^{-2}

Derive the SI units of force.

Derive the SI units of force.

Force = mass x acceleration

Units = kg x m s^{-2}

= kg m s^{-2}

Express 60TΩ in standard form.

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6×10^{13}

(T is tera and the multiplier is 10^{12})

Write 0.000003m with a suitable prefix.

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$3\mu m\ (3 \times 10^{-6} m)$

What is the actual value of 8MΩ?

What is the actual value of 8MΩ?

8,000,000Ω or $8 \times 10^6 \Omega$

What is 6000pF in nF?

What is 6000pF in nF?

6nF (since 1 nF = 1000 pF)

What multiplier is associated with the prefix kilo (k)?

What multiplier is associated with the prefix kilo (k)?

1000 (10^3)

What multiplier is associated with the prefix femto (f)?

What multiplier is associated with the prefix femto (f)?

10^{-15}

Express 7GΩ in standard form.

Express 7GΩ in standard form.

7×10^9 Ω

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 validity?

What is validity?

A measurement is valid if it measures what it is supposed to be measuring. An experimental procedure is valid if the obtained values provide an answer to the question that is being asked.

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.

State three ways of reducing random errors.

- Take at least three repeats and calculate a mean (this increases the likelihood of identifying anomalies).
- Use computers/data loggers.
- 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?

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

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

How can systematic error be reduced?

How can systematic error be reduced?

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?

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

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 makes an experiment repeatable?

What makes an experiment repeatable?

If the original experimenter can redo the experiment with the same equipment and method then get the same results, the experiment is repeatable.

What makes an experiment reproducible?

What makes an experiment reproducible?

If the experiment can be redone by a different person or with different techniques and equipment and the same results are found, it is reproducible.

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 ?

What is the percentage uncertainty in 17 ± 3 A ?

3/17 x 100 = 17.647 %

≈ 18 % (2 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?

The time for 10 swings of a pendulum is 13 ± 0.3 s. 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?

What is the difference between a reading and a measurement?

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
- 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?

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?

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?

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

When multiplying/dividing data add percentage uncertainties

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

% uncertainty = ((0.2 / 7) x 100)+ ((3 / 91) x 100)

= 6.2%

a = 13 ± 6.2%

What is an order of magnitude?

What is an order of magnitude?

Powers of ten which describe the size of an object, and which can also be used to compare the sizes of objects.

What is the order of magnitude for the diameter of a nucleus?

What is the order of magnitude for the diameter of a nucleus?

10^{-15} (femtometres)

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 meant by a scalar quantity?

What is meant by a scalar quantity?

A quantity that has only magnitude.

What is a vector quantity?

What is a vector quantity?

A quantity that has magnitude as well as direction.

Is acceleration a vector or scalar quantity?

Is acceleration a vector or scalar quantity?

Vector.

Is mass a scalar or vector quantity?

Is mass a scalar or vector quantity?

Scalar.

Calculate the magnitude of a force F that is 30º to the horizontal and has a horizontal component of 7.0N.

Calculate the magnitude of a force F that is 30º to the horizontal and has a horizontal component of 7.0N.

$$F_{horizontal} = F\cos\theta$$

$$7.0 = F\cos 30º$$

$$F = 7.0 / \cos 30º = 8.1N$$