# AQA Physics A Level

## Section 1- Measurements and their Errors

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?

Kg (kilogram).

# 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 °C 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 kgms^-2.

# Derive the SI units of energy.

Derive the SI units of energy.

Kinetic energy = ½ x mass x velocity squared

Units = kg x (m/s) x (m/s)

= kgm^2s^-2

# Derive the SI units of force.

Derive the SI units of force.

Force = mass x acceleration

Units = kg x ms^-2

= kgms^-2

Express 60TΩ in standard form.

Express 60TΩ in standard form.

6 x 10^13

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

Write 0.000003m with a suitable prefix.

Write 0.000003m with a suitable prefix.

3μm

What is the actual value of 8MΩ?

# What is the actual value of 8MΩ?

8,000,000Ω  or 8x10^6Ω

# What is 6000pF in nF?

# What is 6000pF in nF?

6nF as 1 nano unit is 1000 pico units.

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 is standard form.

Express 7GΩ is standard form.

7 x 10^9 Ω

# What is 1 eV in J?

# What is 1eV in J

1eV= 1.6 x 10^-19 J

Express 6kWh in joules.

Express 6kWh in joules.

6 kW = 6000 J/s  1 hour= 3600s

6kWh = 6000 x 3600

= 21.6 x 10^6 J

= 21.6 MJ

# Convert 6.6pJ to eV.

Convert 6.6pJ to eV.

6.6pJ= 6.6 x 10^-12 J

Divide by 1.6 x 10^-19

6.6pJ=4.1 x 10^7 eV (2sf)

=41MeV

# What is a random error?

# What is a random error?

An error that affects precision and cannot be completely removed, it causes differences in measurements.

# What is a systematic error?

## What is a systematic error?

An error that affects accuracy and occurs due to faults in equipment or experimental method, causing the result to be too large / small by the same amount each time.

# What are 3 ways to reduce random error?

What are three ways to reduce random error?

- Take at least 3 repeats and calculate a mean.
- Use a computer or a data logger.
- 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.

State a cause of parallax error.

State a cause of parallax error.

Reading a scale at a different angle each time, to correct this you should read scales at eye level to reduce parallax error.

# 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?

It is a 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 is reduced.

# What is precision?

# What is precision?

Precise measurements are consistent, they fluctuate slightly about a mean value - this doesn't indicate the value is accurate.

# What is repeatability?

# What is repeatability?

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

# What is reproducibility?

# What is reproducibility?

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

# 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.

# What is meant if a value is accurate?

What is meant if a value is accurate?

If the value is close to the true value.

# 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 ?

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

$= 18\ \%$ (2sf)

What is the fractional uncertainty of 8 +/- 0.5 m?

What is the fractional uncertainty of 8 +/- 0.5 m?

0.5/8 = 1/16 (0.0625)

# How can percentage and fractional uncertainty be reduced?

How can percentage and fractional uncertainty be reduced?

Measure larger quantities e.g. a longer rope will have a smaller percentage uncertainty than a shorter one.

The time for 10 swings of a pendulum is 13 +/- 0.3s, what is the time and uncertainty for 1 swing?

The time for 10 swings of a pendulum is 13 +/- 0.3s, what is the time and uncertainty for 1 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 2 readings is found.

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

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

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

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 uncertainty in the measurement = ±1mm

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

2 ± 5% cm

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

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

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

= 1.6 x 10^-19 ± 0.1 x 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.

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.

Mean : 3.2+3.6+3.1=9.9 9.9/3 = 3.3 s

Uncertainty = half the range (3.6-3.1) / 2 = 0.25

= 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± 0.7V.

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 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 ms^-2

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

=6 .2%

a = 13 ± 6.2%

The radius of a circle is 50.3 cm, what is the percentage uncertainty in the area of the circle?

The radius of a circle is 50.3 cm, what is the percentage uncertainty in the area of the circle?

When a value is raised to a power, multiply the % uncertainty by the power.

Area = π x 25 = 78.5 cm^2

Area = πr^2

% uncertainty in radius = 0.35  100 = 6%

% uncertainty in area = 6 x 2 (2 is the power from r^2) = 12%

78.5 12% cm^2

When drawing a line of best fit on a graph with error bars what must you do?

When drawing a line of best fit on a graph with error bars what must you do?

Make sure the line of best fit goes through all the error bars.

# How do you find the uncertainty in the gradient of a line of best fit?

How do you find the uncertainty in the gradient of a line of best fit?

Draw a steepest or shallowest line of worst fit, it must go through all the error bars.

Calculate the gradient of the best and worst line, the uncertainty is the difference between the best and worst gradients.

# How can you find the percentage uncertainty in the gradient of a line of best fit?

# How can you find the percentage uncertainty in the gradient of a line of best fit?

*Percentage uncertainty =*

*| best gradient-worst gradient | / best gradient x 100*

(modulus lines show it's always positive)

# How do you work out the uncertainty in the y - intercept of a line of best fit?

# How do you work out the uncertainty in the y-intercept of a line of best fit?

Draw a best and worst line of fit, you can find the uncertainty in the y - intercept by:

$$| \textit{best y-intercept} - \textit{worst y-intercept} |$$

# How do you find the percentage uncertainty in a y intercept?

How do you find the percentage uncertainty in a y intercept?

*percentage uncertainty =*

*| best y-intercept - worst y-intercept |*

*/ best y intercept x 100*

# 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

# What is estimation?

# What is estimation?

A skill physicists must use in order to approximate the values of physical quantities, in order to make comparisons, or to check if a value they've calculated is reasonable.

What is 9.71 x 10^-21 to the nearest order of magnitude?

What is 9.71x10^-21 to the nearest order of magnitude?

It is 1x10^-20 to 1sf.

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