CAIE Physics A-level

1 - Physical Quantities and Units

Flashcards

What are the two components of which all physical quantities must be comprised?

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Physical quantities comprise a numerical magnitude and a unit.

Give some examples physical quantities?

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3A (3 amperes of current), 20N (20 Newtons of force) and 80J (80 Joules of energy) are all examples of physical quantities

Why are estimation skills important for scientists and engineers?

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Estimation skills allow scientists to ‘ground truth’ their calculations. Therefore they are able to check whether or not their calculations are reasonable.

What are SI units?

What are SI units?

The fundamental (base) units of physical quantities.

What is the SI unit of mass?

What is the SI unit of mass?

Kilograms (kg)

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 ?

Kelvin (K) as this is the absolute scale for temperature.

What is the SI unit of length?

What is the SI unit of length?

Metre, m

What quantity has an SI unit of seconds (s)?

What quantity has an SI unit of seconds (s)?

Time

Are Newtons (N) an SI unit?

Are Newtons (N) an SI unit?

No, Newtons are not fundamental. The SI units for force are $kgms^{-2}$ (since F = ma).

Derive the SI units of force.

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Force = mass x acceleration

Units = kg x m s^{-2}

= $kgms^{-2}$

Derive the SI units of energy.

Derive the SI units of energy.

$$\textit{Kinetic energy} = \tfrac{1}{2} \times \textit{mass} \times \textit{velocity}^2$$

$$\text{Units} = \text{kg} \times (\text{m/s})^2 = \text{kg m}^2\,\text{s}^{-2}$$

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?

$8{,}000{,}000\Omega$ 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)?

x1000 (10^3)

Express 7GΩ in standard form.

Express 7GΩ in standard form.

$7 \times 10^9\ \Omega$

What is a homogeneous equation?

What is a homogeneous equation?

A homogeneous equation is one that has the same SI base units on both sides of the equals sign. All correct equations in the natural world are homogeneous.

How could you check if an equation is homogeneous, for example does $1 Nkg^{-1} = 1 ms^{-2}$?

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You can reduce both sides of the equation to their SI base units and see if they match. In this example:

$LHS = 1Nkg^{-1} = 1kgms^{-2}kg^{-1} = 1ms^{-2} = RHS$,

so this is a homogeneous equation

What are the two main categories of experimental error?

What are the two main categories of experimental error?

Systematic Error and Random Error

What is systematic error?

What is systematic error?

Systematic error affects measurements in the same manner upon repetition i.e. measurements will be higher or lower than their true value by a consistent amount.

What are some causes of systematic error?

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Reading a scale from an angle (parallax error), not zeroing a balance correctly (zero error), incorrectly set-up apparatus, or faulty equipment.

How can systematic error be avoided as best as possible?

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By reading any scale at its appropriate level (avoiding parallax error), zeroing any balances correctly (avoiding zero error), setting up apparatus correctly and replacing faulty equipment, once identified as broken.

What is random error?

What is systematic error?

Random error affects measurements differently upon every experimental repetition i.e. measurements may be higher or lower than their true value by varying amounts.

What are some causes of random error?

What are some causes random error?

Some examples of human error, such as timing pendulum oscillations, small inconsistencies in the behaviour of equipment upon repetition e.g. slight heating up of a resistor.

How can random error be avoided as best as possible?

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Random error is difficult to avoid completely, however can be mitigated by taking repeat readings and averaging. Any anomalous results should be discounted.

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 a magnitude as well as a 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.

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

$$7.0 = F\cos 30º$$

$$F = 7.0 / \cos 30º = 8.1N$$

Draw the vector addition of the following:

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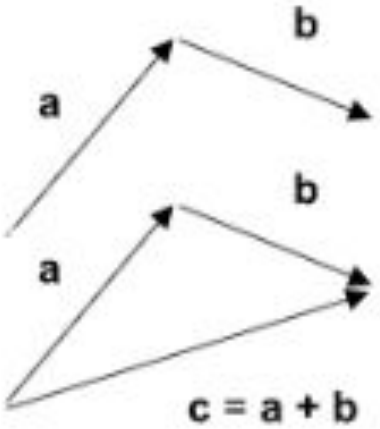

Draw the vector subtraction of the following:

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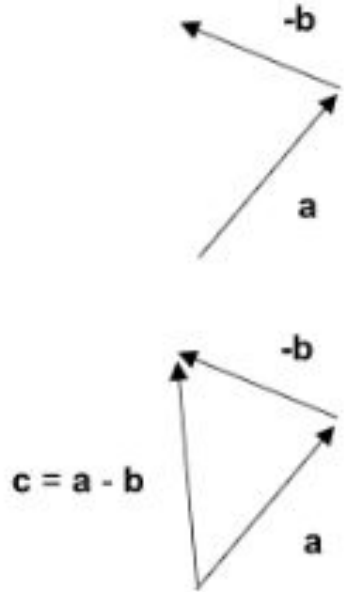
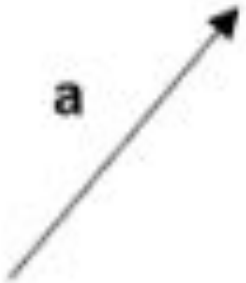


Draw how you would resolve this vector into horizontal and vertical components.



Draw how you would resolve this vector into horizontal and vertical components.