OCR (B) Physics A-level

PAG 02.1 - Determining Young Modulus

Practical Flashcards

Define Young's Modulus.

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The Young's Modulus of a material its ratio of tensile stress to tensile strain. It is a measure of a material's stiffness.

How is stress calculated?

How is stress calculated?

Stress = Force / Cross-Sectional Area

How is strain calculated?

How is strain calculated?

Strain = Change in Length / Original Length

What is the unit of stress?

What is the unit of stress?

Pascals (Pa) or Nm^{-2}

What is the unit of strain?

What is the unit of strain?

Strain doesn't have a unit since it is a ratio of two lengths.

What is the unit of Young's Modulus?

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Pascals (Pa) or Nm^{-2}

How can the cross-sectional area of a thin wire be measured?

How can the cross-sectional area of a thin wire be measured?

The wire's diameter should be measured in several places along the wire, using a micrometer. The average diameter can then be used to calculate the circular area.

What safety precaution should be taken when stretching thin wires?

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Safety goggles should be worn since the wire may snap when under a tensile load and this could cause an eye injury.

Why should the temperature of the surroundings be kept constant when carrying out this experiment?

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Metals undergo thermal expansion when there is a temperature increase, and this would change the dimensions of the wire.

Why should a pre-stress be applied to the wire when setting up this experiment?

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A pre-stress should be applied so that all kinks in the wire are removed and the wire is taught, before measurements are taken.

How can the Young's Modulus be determined from a graph of extension against load?

How can the Young's Modulus be determined from a graph of extension against load?

The gradient of the graph is e/F

E= L/(A x Gradient)

How can Young's Modulus be obtained from a stress-strain graph?

How can Young's Modulus be obtained from a stress-strain graph?

The gradient of a stress-strain graph will give you Young's Modulus.

Suggest what has happened if the length of the wire doesn't return to its original length when unloaded.

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If the wire doesn't return to its original length when unloaded, the load may have exceeded the wire's elastic limit and consequently the wire has undergone plastic deformation.

How can the load applied on a wire be calculated from the mass added to the end of the wire?

How can the load applied on a wire be calculated from the mass added to the end of the wire?

Load = Mass x Gravitational Field Strength

$$F = mg$$

What safety precaution should be taken when using hanging masses?

What safety precaution should be taken when using hanging masses?

Never stand with your feet below the hanging masses in case the wire snaps and the masses fall. It is good practice to place a padded bucket below them.

Suggest how the extension of the wire may be measured.

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A marker, such as a small piece of tape, could be added to the wire. A ruler could then be placed underneath the wire, allowing the movement of the marker to be measured.

Why is the choice of wire diameter important in obtaining successful results?

Why is the choice of wire diameter important in obtaining successful results?

If the wire is too thick, the extension will be too small to measure. If the wire is too thin, the wire may begin to deform plastically before a good range of results have been obtained.

Suggest why a comparison test wire is used when conducting this experiment using Searle's apparatus.

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A comparison wire is included so that any changes in the environmental conditions, such as a change in temperature, are accounted for and won't skew the results obtained.

Why is your choice of wire length important in this experiment?

Why is your choice of wire length important in this experiment?

The extension of the wire depends on the wire's length since: $x = FL/AE$

This means the length needs to be sufficiently long enough for the extensions to be easily measurable.

Suggest how the wire may be fixed in place when carrying out this experiment.

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The wire can be clamped tightly between two blocks of wood at one end. These blocks can then be clamped to the bench.

Alongside a metre ruler, what other tool will help you measure the extension accurately?

Alongside a metre ruler, what other tool will help you measure the extension accurately?

A set-square can be used to help read the extension accurately.

When measuring the diameter of the wire in multiple places, why should you rotate the wire between measurements?

When measuring the diameter of the wire in multiple places, why should you rotate the wire between measurements?

You should measure the wire in different orientations to ensure that the wire is circular across the full-length of the wire.

How can the percentage difference in your experimental value and accepted value be calculated?

How can the percentage difference in your experimental value and accepted value be calculated?

[(Your Value - Accepted Value)/Accepted Value] x 100%