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QUESTION WORKBOOK

Stress, strain and the Young modulus

Materials · Year 12

AQA 3.4.2.2 · CIE 6.1 · OCR A 3.4.2

10 questions · 30 marks

NAVY SCREEN EDITION

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SECTION A · Warm-up

A1 Define tensile stress and tensile strain, stating the unit of each. [2]

A2 A wire of cross-sectional area 2.0×10^{-6} m^2 carries a tension of 40 N. Calculate the tensile stress. [2]

A3 A wire of original length 2.5 m extends by 1.0 mm. Calculate the tensile strain. [2]

SECTION B · Standard

B1 A wire of length 2.0 m and cross-sectional area 1.5×10^{-6} m^2 extends by 0.80 mm when a force of 60 N is applied. Calculate (a) the stress, (b) the strain and (c) the Young modulus of the wire. [4]

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B2 A steel wire ($E = 2.0 \times 10^{11}$ Pa) has length 3.0 m and cross-sectional area 1.0×10^{-6} m^2. Calculate its extension under a tension of 50 N. [3]

B3 Sketch a typical stress–strain graph for a ductile metal wire and mark the limit of proportionality and the elastic limit. State how the Young modulus is found from the graph. [3]

B4 For the wire in the four-mark question above (60 N, 0.80 mm extension), calculate (a) the elastic strain energy stored and (b) the energy stored per unit volume. [3]

SECTION C · Stretch

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C1 A wire has a breaking stress of 4.0×10^{8} Pa and a diameter of 0.50 mm. Calculate the maximum tension it can support before breaking. [4]

C2 A steel wire ($E = 2.0 \times 10^{11}$ Pa) of length 1.5 m must support a 100 N load while extending by no more than 0.50 mm. Calculate the minimum cross-sectional area required and the corresponding minimum diameter. [4]

C3 Describe a simple laboratory method for measuring the Young modulus of a metal in the form of a wire, naming the measurements you would take. [3]

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