

12 A student carried out an experiment to determine the Young modulus of constantan.

The student had a constantan wire with cross-sectional area A of $3.97 \times 10^{-7} \text{ m}^2$.

The unstretched length x of the wire was 4.00 m.

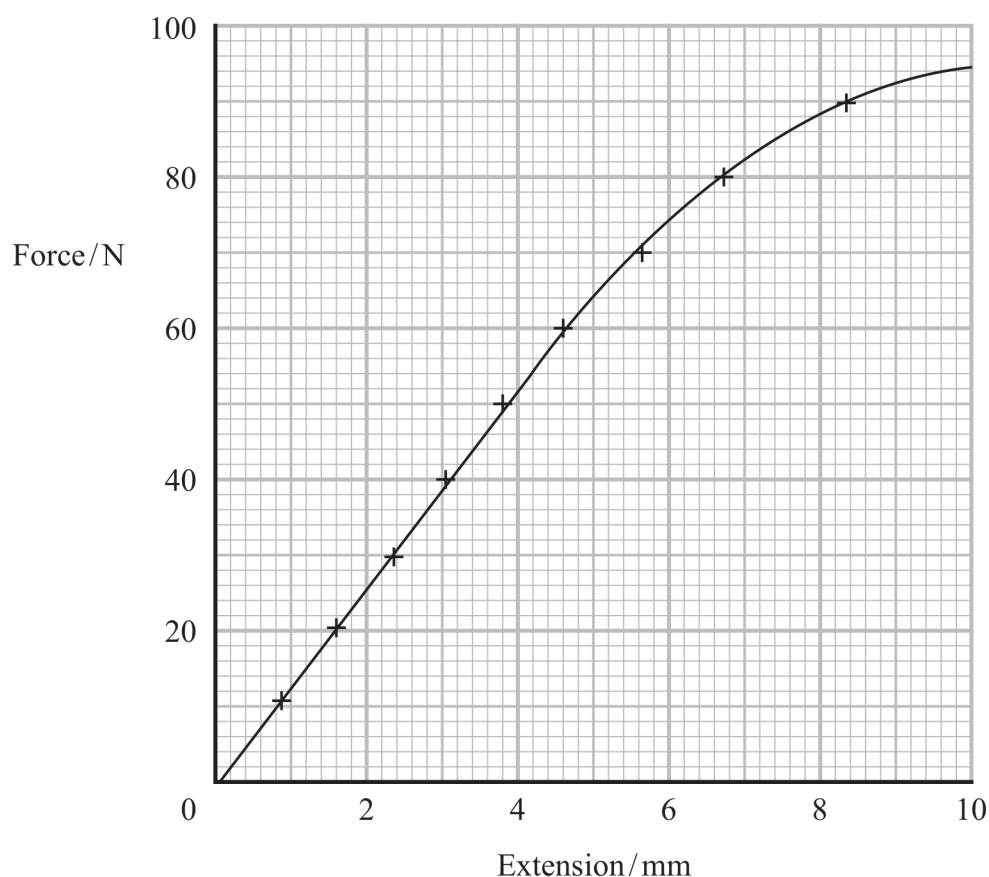
(a) The student had enough slotted masses to apply a weight of up to 150 N to the wire.

The breaking stress for constantan is about 420 MPa.

Deduce whether the wire could support a weight of 150 N.

(3)

(b) The student added slotted masses to the wire and determined the corresponding extensions. The student plotted a graph of force against extension, as shown.



- (i) Show that the stiffness of the wire is about $1.3 \times 10^4 \text{ N m}^{-1}$.

(2)

- (ii) The relationship between the stiffness k of the wire and the Young modulus E is given by

$$k = \frac{EA}{x}$$

where x is the unstretched length of the wire and A is the cross-sectional area of the wire.

Determine a value for the Young modulus of constantan using the student's data.

(2)

Young modulus =

(Total for Question 12 = 7 marks)