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 3.97×10^{-7} m^2.

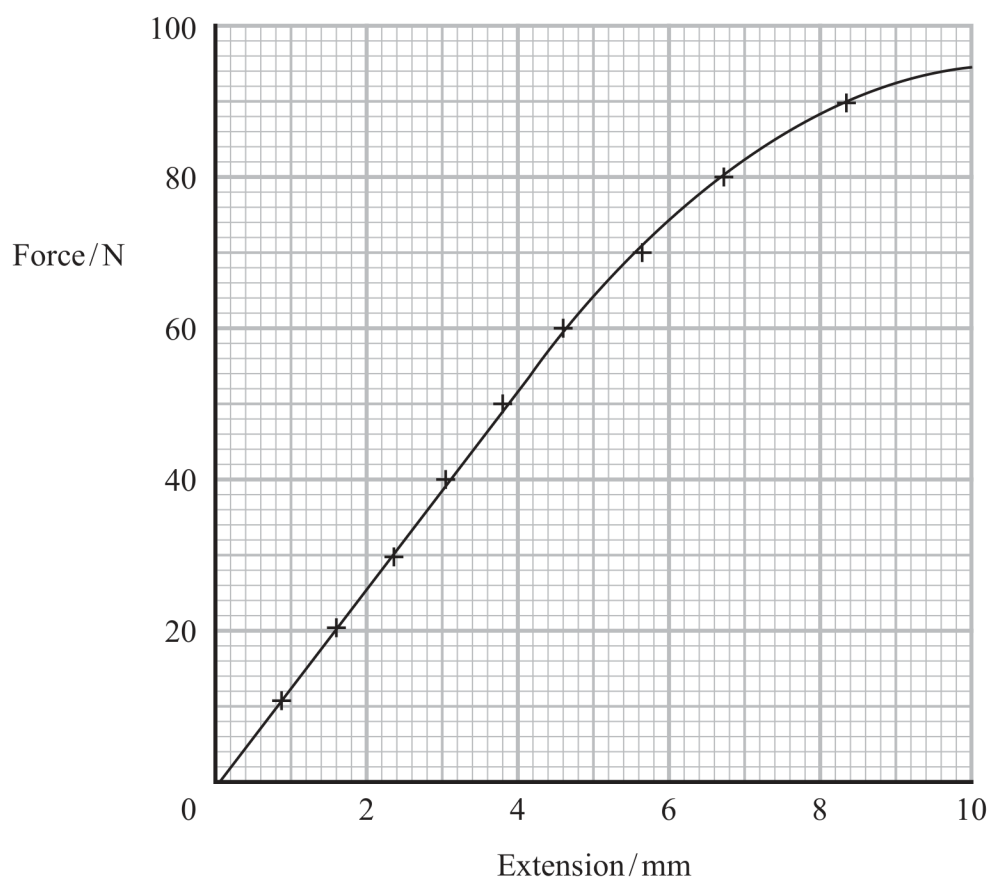The unstretched length x of the wire was 4.00 m.

(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)

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(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.

P7 1 8 7 8 A 0 1 0 2 8

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

(2)

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(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)

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Young modulus = ...

(Total for Question 12 = 7 marks)