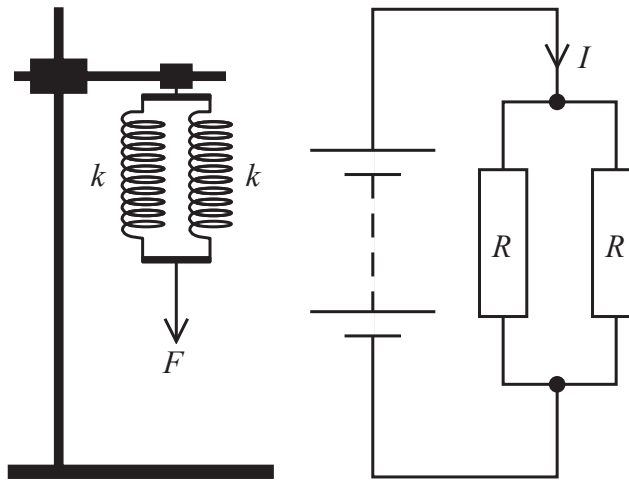


- 6 A student is experimenting with different combinations of springs and recalls that in physics it is often possible to model different physical situations in similar ways.

The student suggests that a parallel combination of springs could be a model for a parallel combination of resistors in a circuit.



- (a) Derive an expression for the effective resistance R_{eff} of two resistors R_1 and R_2 connected in parallel in a circuit.

(3)

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- 10 Seat belts are being tested by a car manufacturer. In the test, a car moving at a steady speed of 28 m s^{-1} collides with a wall and stops.

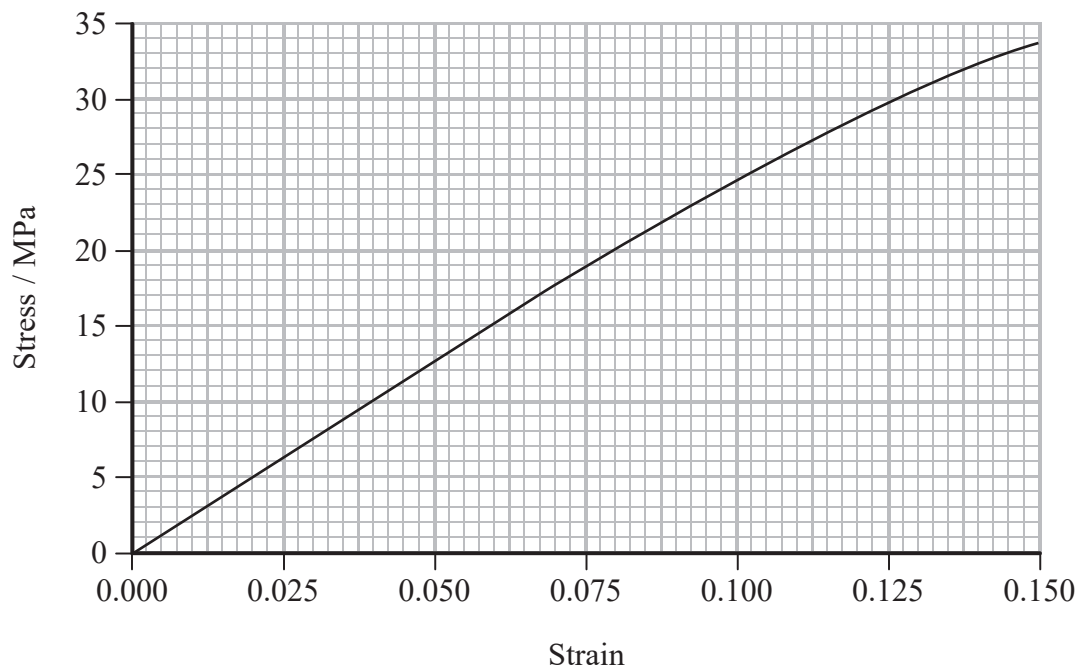
A crash-test dummy in the driving seat is wearing a seat belt made from polyester webbing. The seat belt has a cross-sectional area of 0.85 cm^2 and a total length of 2.0 m . A student suggests that in the collision the seat belt absorbs all the kinetic energy of the dummy.

- (a) Show that the energy per unit volume that would have to be absorbed by the seat belt is about $2 \times 10^8 \text{ J m}^{-3}$.

mass of dummy = 75 kg

(3)

- (b) The graph shows how stress varies with strain for the seat belt.



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- (i) Show that the area under the graph represents the energy stored per unit volume in the seat belt.

(2)

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- (ii) Use the graph to determine whether the seat belt absorbs all the kinetic energy of the dummy from part (a).

In this collision, the maximum strain of the seat belt is 0.075

(3)

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(Total for Question 10 = 8 marks)

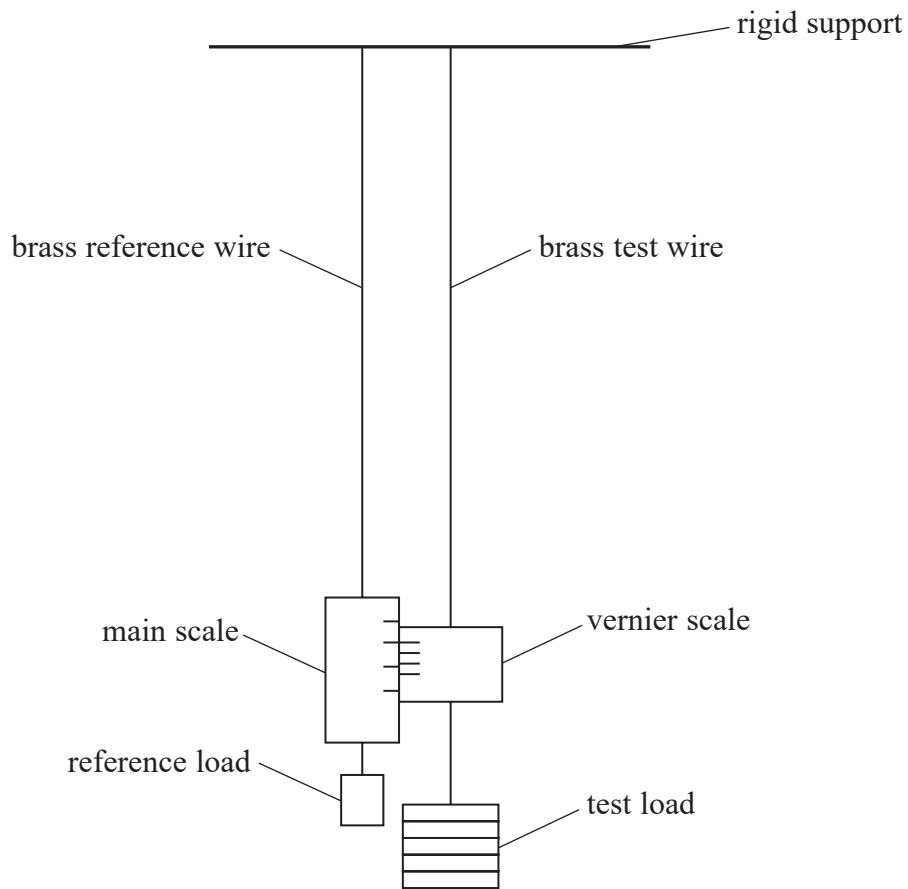
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- 5 A student used the apparatus shown to determine the Young modulus of brass. Loads were added to the test wire and corresponding readings taken from the vernier scale. The test wire and the reference wire were identical.



- (a) (i) Give one advantage of using a reference wire as well as a test wire.

(1)

- (ii) State why a reference load was applied to the reference wire.

(1)



(b) Explain why the test wire should be both long and thin.

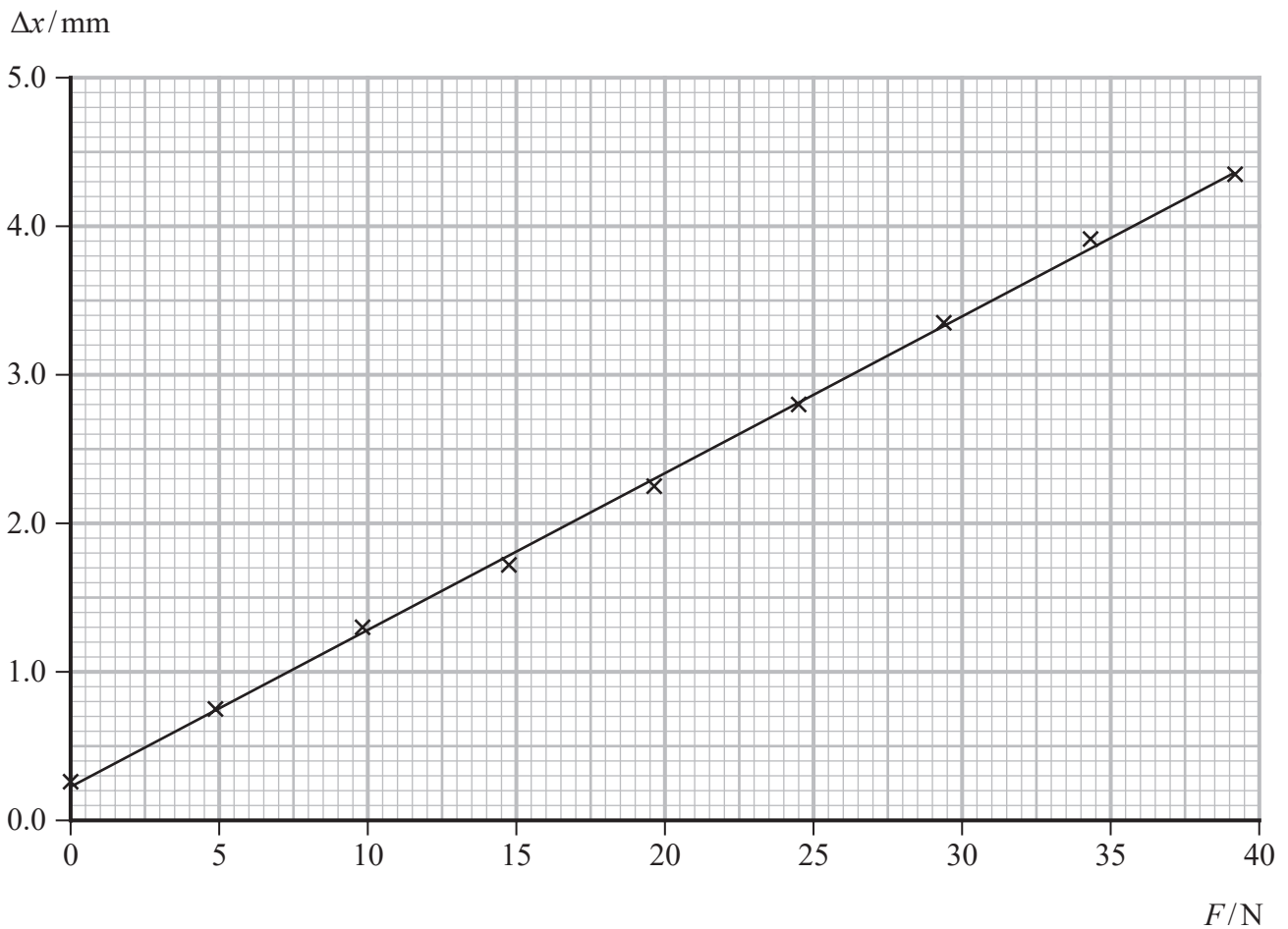
(3)

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(c) The student varied the load F on the test wire and recorded the corresponding change in length Δx from the vernier scale. The results are shown on the graph.



Determine a value for the Young modulus of brass.

length of wire = 2.75 m

diameter of wire = 5.60×10^{-4} m

(5)

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Young modulus of brass =

(Total for Question 5 = 10 marks)

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