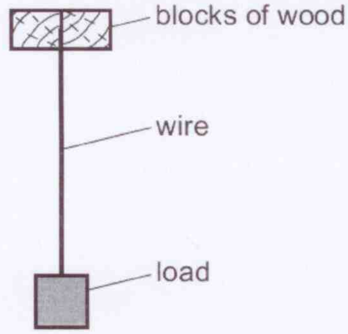
Deformation of solids - 2018

1. 9702/11/M/J/18/No.18

The diagram shows a wire of diameter D and length L that is firmly clamped at one end between two blocks of wood. A load is applied to the wire which extends its length by x.



A second wire is made of the same material, but of diameter $2D$ and length $3L$. Both wires obey Hooke's law.

What is the extension of the second wire when the same load is applied?

A $\frac{2}{3}x$ **B** $\frac{3}{4}x$ **C** $\frac{4}{3}x$ **D** $\frac{3}{2}x$

2. 9702/12/M/J/18/No.20

An elastic material with Young modulus E is subjected to a tensile stress S. Hooke's law is obeyed.

What is the expression for the elastic energy stored per unit volume of the material?

A $\frac{E}{2S^2}$ **B** $\frac{2E}{S^2}$ **C** $\frac{S^2}{E}$ **D** $\frac{S^2}{2E}$

3. 9702/11/M/J/18/No.19

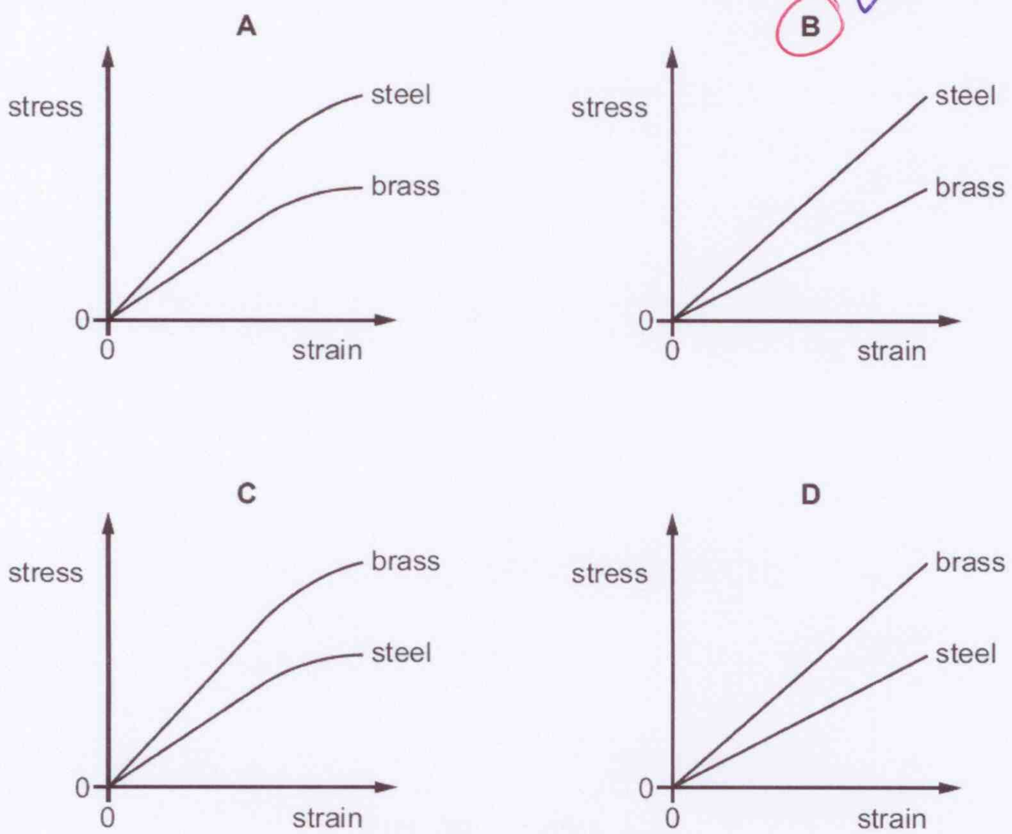
Two wires, one made of brass and the other of steel, are stretched in an experiment. Both wires obey Hooke's law during this experiment.

The Young modulus for brass is less than the Young modulus for steel.

$E_{Brass} < E_{steel}$

Which graph shows how the stress varies with strain for both wires in this experiment?

– So Steel has a steeper gradient in σ–ε Graph.



4. 9702/13/M/J/18/No.18

Data for a steel wire on an electric guitar are listed.

diameter = 5.0×10^{-4} m

Young modulus = 2.0×10^{11} Pa

tension = 20 N

The wire snaps and contracts elastically. Assume the wire obeys Hooke's law.

By what percentage does the length l of a piece of the wire contract?

A 1.3×10^{-4} % **B** 5.1×10^{-4} % **C** 1.3×10^{-2} % **D** 5.1×10^{-2} %

$x = \frac{FL}{AE} = \frac{20 \times l}{\pi \times \left(\frac{5.0\times10^{-4}}{2}\right)^2 \times 2\times10^{11}}$

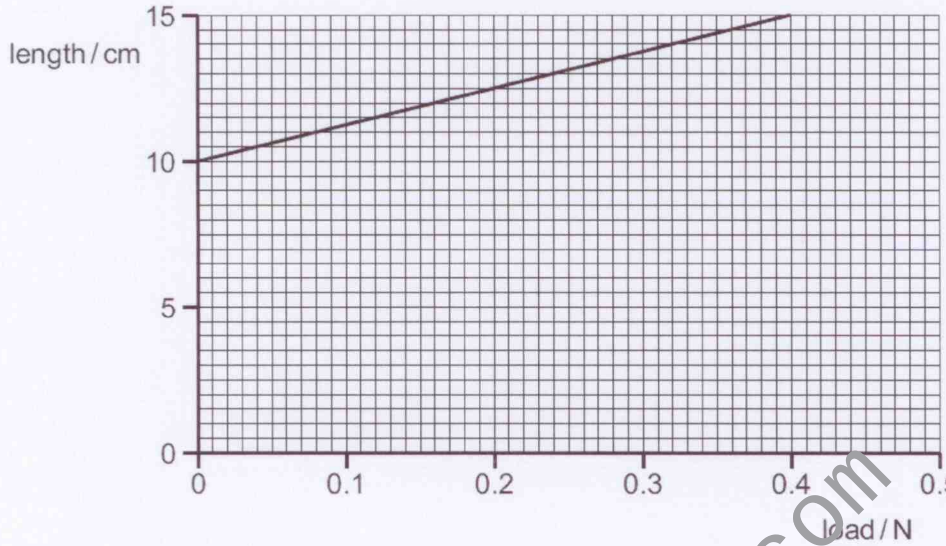
$x = 0.000051 l$

$\frac{x}{l} = 0.000051$

$\frac{x}{l}\% = 0.000051 \times 100 = 0.051\% = 5.1 \times 10^{-2}\%$

5. 9702/12/M/J/18/No.22

The graph shows the length of a spring as it is stretched by an increasing load.



What is the spring constant of the spring?

A $0.080\,N\,m^{-1}$ **B** $0.13\,N\,m^{-1}$ **C** $2.7\,N\,m^{-1}$ **D** $8.0\,N\,m^{-1}$

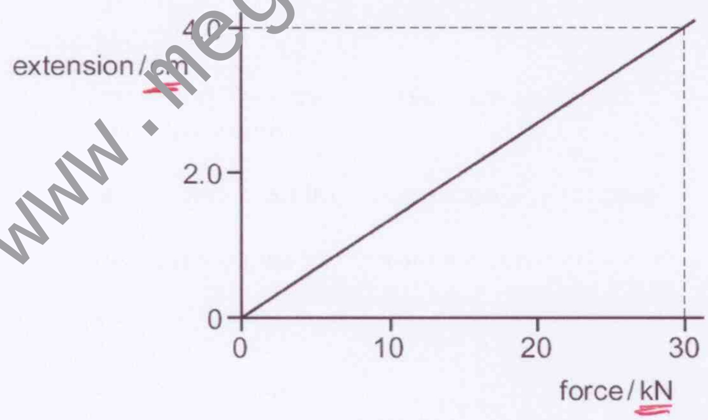
$k = \frac{F}{\Delta x}$ = gradient

$= \frac{0.4 - 0}{0.15 - 0.1} = \frac{0.4}{0.05}$

$= 8.0\,N\,m^{-1}$

6. 9702/13/M/J/18/No.19

The graph shows how the extension of a spring varies with the force used to stretch it.



$E = \frac{1}{2}Fx$

$= \frac{1}{2} \times 30000 \times 0.04$

$= 600\,J$

– change force from kN to N by multiplying by 1000
– change cm to m.

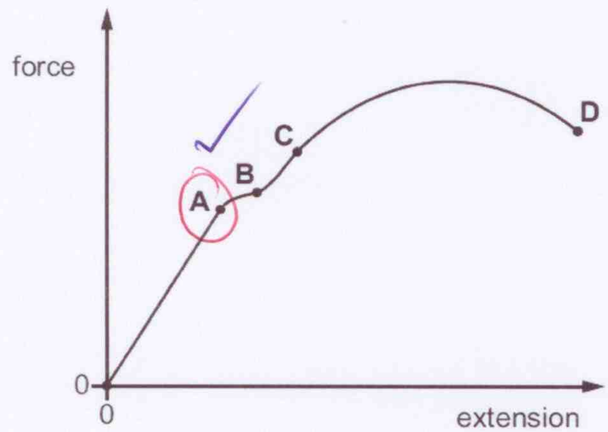
What is the strain energy in the spring when the extension is 4.0 cm?

A 60 J **B** 120 J **C** 600 J **D** 1200 J

7. 9702/12/F/M /18/No.19

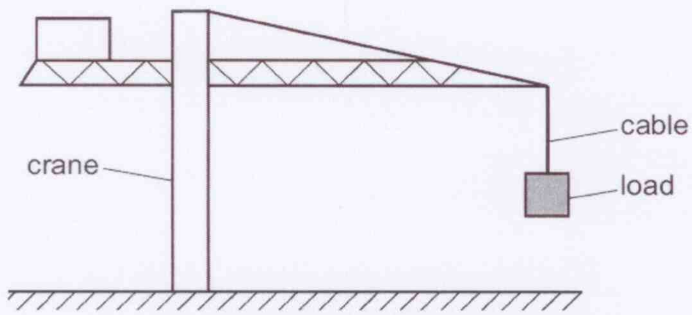
The force-extension graph of a metal wire is shown.

At which point on the graph does the metal wire stop obeying Hooke's law?



8. 9702/12/F/M /18/No.20

The diagram shows a large crane on a construction site lifting a cube-shaped load at a constant speed.



A model is made of the crane, its load and the cable supporting the load.

The material used for each part of the model is the same as that in the full-size crane, cable and load. The model is one tenth full-size in all linear dimensions.

What is the ratio $\dfrac{\text{stress in the cable on the full-size crane}}{\text{stress in the cable on the model crane}}$?

A 0.1 **B** 1 **C** 10 **D** 100