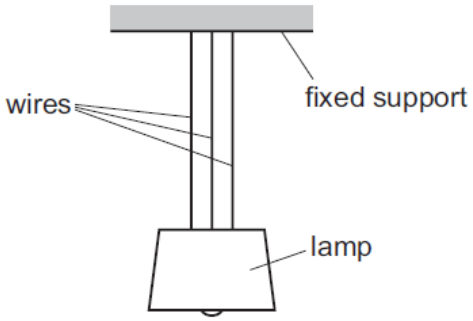
Deformation of Solid – 2023 June AS Physics 9702

1. June/2023/Paper_ 9702/11/No.18

A lamp is suspended in equilibrium from a fixed support by three long identical wires.



The weight of the lamp causes each wire to have an extension of 0.40 cm. The height h of the lamp above the floor is measured.

The middle wire suddenly breaks and the lamp falls a small distance as the extensions of the remaining two wires increase. The wires obey Hooke's law.

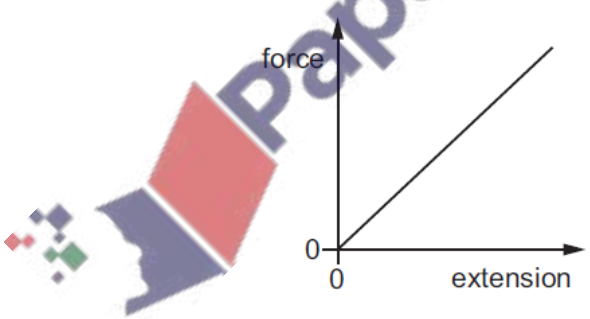
When the lamp is in equilibrium, the height h of the lamp above the floor is measured again.

What is the difference between the two values of h?

A 0.20 cm **B** 0.27 cm **C** 0.40 cm **D** 0.60 cm

2. June/2023/Paper_ 9702/11/No.19

The force–extension graph for a spring is shown.



What represents the work done to extend the spring?

A the area under the graph

B the gradient of the graph

C the reciprocal of the gradient of the graph

D twice the area under the graph

3. June/2023/Paper_ 9702/12/No.18

What is meant by the spring constant of a spring?

A extension per unit force

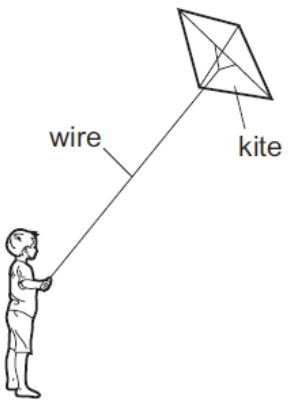
B $\frac{1}{2} \times$ force $\times$ extension

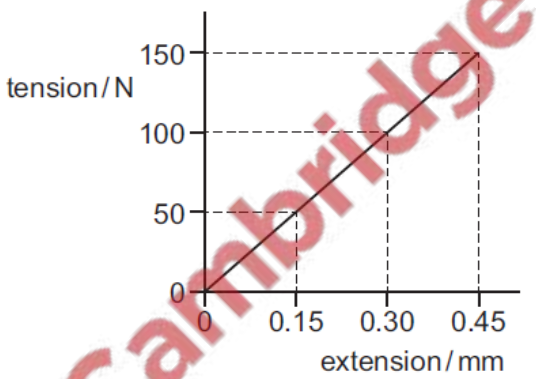
C force $\times$ extension

D force per unit extension

4. June/2023/Paper_ 9702/12/No.19

A child holds a thin metal wire that is attached to a kite. The graph shows how the extension of the wire varies with its tension.





A gust of wind increases the tension from 100 N to 150 N.

What is the change in the elastic potential energy of the wire caused by the gust of wind?

A 3.8 mJ **B** 19 mJ **C** 34 mJ **D** 38 mJ

5. June/2023/Paper_ 9702/13/No.18

A metal wire has length 5.2 m and diameter 1.0 mm. The metal has Young modulus 360 GPa.

The wire is fixed at one end and a force is applied to the other end. The force extends the wire by 7.2 mm. The wire obeys Hooke's law.

What is the force applied to the wire?

A 1.2×10^2 N

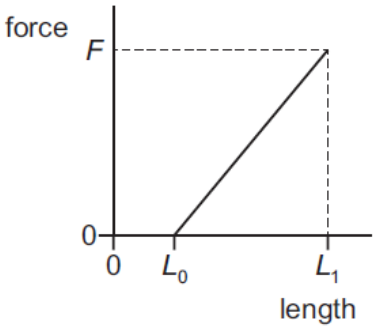
B 3.9×10^2 N

C 5.0×10^2 N

D 1.6×10^3 N

6. June/2023/Paper_ 9702/13/No.19

The graph shows how the length of a spring varies with the force applied to it.



The spring has unstretched length L_0. When a force F is applied, the spring has length L_1.

What is the work done in stretching the spring to length L_1?

A $\frac{1}{2}FL_1$ **B** $\frac{1}{2}F(L_1 - L_0)$ **C** FL_1 **D** $F(L_1 - L_0)$

7. June/2023/Paper_ 9702/22/No.4

A spring is suspended from a fixed point at one end. The spring is extended by a vertical force applied to the other end. The variation of the applied force F with the length L of the spring is shown in Fig. 4.1.

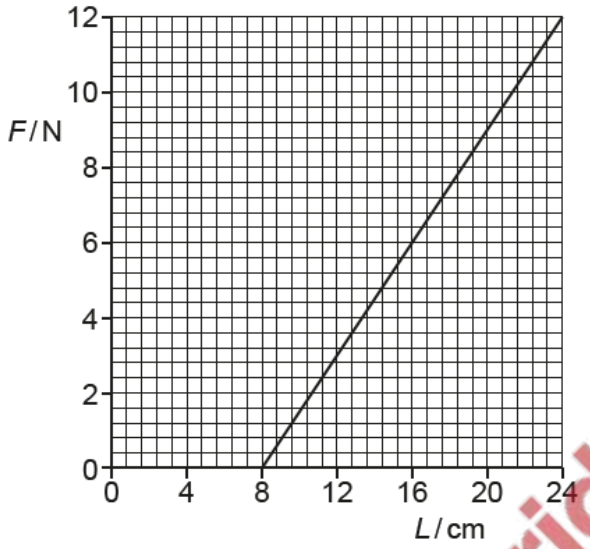


Fig. 4.1

For the spring:

(a) state the name of the law that gives the relationship between the force and the extension

..... [1]

(b) determine the spring constant, in $N\,m^{-1}$

spring constant = ...$N\,m^{-1}$ [2]

(c) determine the elastic potential energy when $F = 6.0\,\text{N}$.

elastic potential energy = ... J [2]

[Total: 5]

8. June/2023/Paper_ 9702/23/No.6

(a) Define the Young modulus.

.....

..... [1]

(b) A uniform wire is suspended from a fixed support. Masses are added to the other end of the wire, as shown in Fig. 6.1.

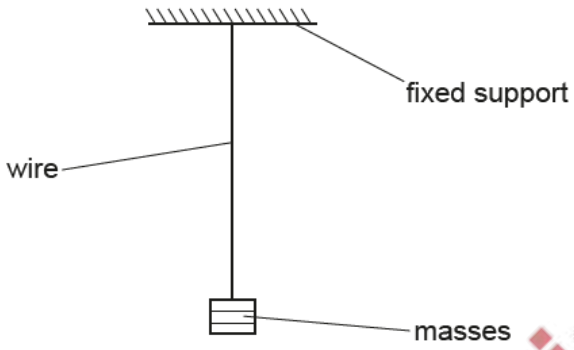


Fig. 6.1 (not to scale)

The variation of the length l of the wire with the force F applied to the wire by the masses is shown in Fig. 6.2.

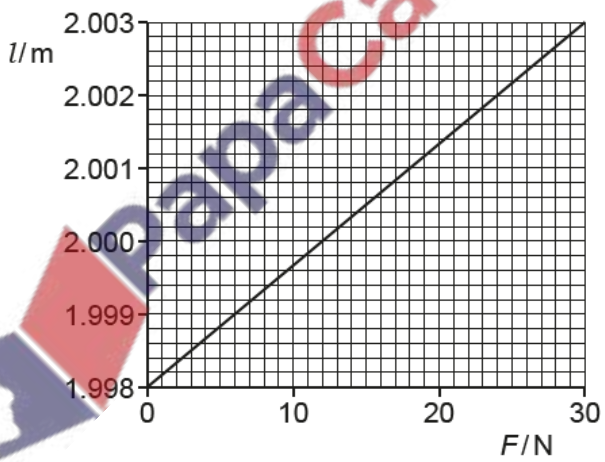


Fig. 6.2

The cross-sectional area of the wire is 0.95 mm^2.

(i) Determine the unstretched length of the wire.

unstretched length = ... m [1]

(ii) For an applied force F of 30 N, determine:

- the stress in the wire

stress = ... Pa

- the strain of the wire.

strain = ...

[3]

[Total: 5]

9. March/2023/Paper_ 9702/12/No.18

A spring has an unstretched length of 4.50 cm. The spring is fixed at one end and a force of 35.0 N is applied to the other end so that the spring extends.

The spring obeys Hooke's law and has a spring constant of 420 $N\,m^{-1}$.

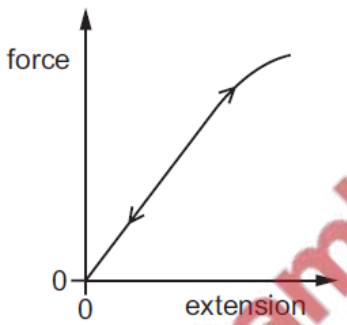
What is the strain of the extended spring?

A 0.019 **B** 0.083 **C** 1.85 **D** 2.67

10. March/2023/Paper_ 9702/12/No.19

A wire is fixed at one end and extended by a force that is applied to the other end. The force is slowly increased from zero and then slowly decreased back to zero.

The force–extension graph for the wire is shown.



The graph line for the wire being loaded is the same as the graph line for the wire being unloaded.

Which statement describes the deformation of the wire?

A It is both elastic and plastic.

B It is elastic only.

C It is neither elastic nor plastic.

D It is plastic only.

11. March/2023/Paper_ 9702/22/No.2a (i)

A motor uses a wire to raise a block, as illustrated in Fig. 2.1.

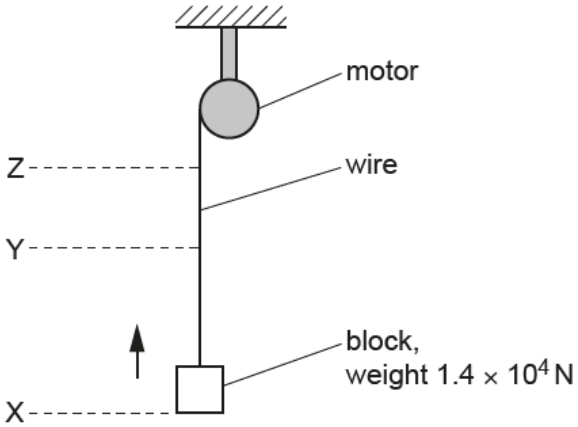


Fig. 2.1 (not to scale)

The base of the block takes a time of 0.49 s to move vertically upwards from level X to level Y at a constant speed of 0.64 m s^{-1}. During this time the wire has a strain of 0.0012. The wire is made of metal of Young modulus 2.2 × 10^{11} Pa and has a uniform cross-section.

The block has a weight of 1.4 × 10^4 N. Assume that the weight of the wire is negligible.

(a) Calculate:

(i) the cross-sectional area A of the wire.

A = ... m^2 [2]