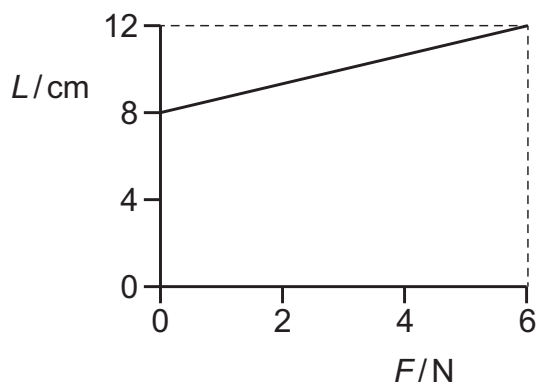


- 20** A spring is fixed at one end. The length L of the spring is increased by applying a tensile force F to the other end.

The graph shows the variation of L with F .



What is the elastic potential energy of the spring when F is 6.0 N?

- A** 0.12 J **B** 0.24 J **C** 0.36 J **D** 0.60 J

- 21** A wire has an unstretched length of 2.00 m.

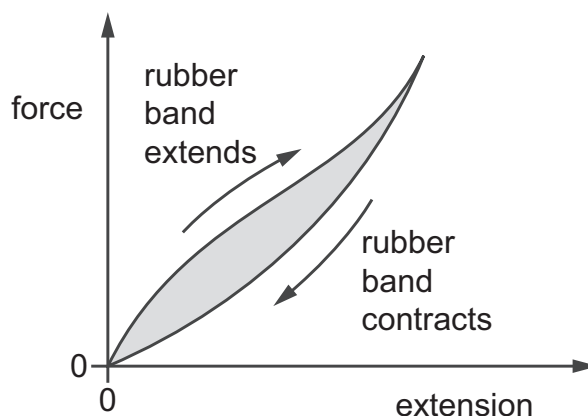
A stress of $1.6 \times 10^5 \text{ Pa}$ is applied to the wire, and the new length of the wire is 2.10 m.

The wire obeys Hooke's law.

What is the Young modulus of the wire?

- A** $8.0 \times 10^3 \text{ Pa}$ **B** $7.8 \times 10^4 \text{ Pa}$ **C** $1.5 \times 10^5 \text{ Pa}$ **D** $3.2 \times 10^6 \text{ Pa}$

- 23** The diagram shows a force–extension graph for a rubber band as the band is extended and then the stretching force is decreased to zero.

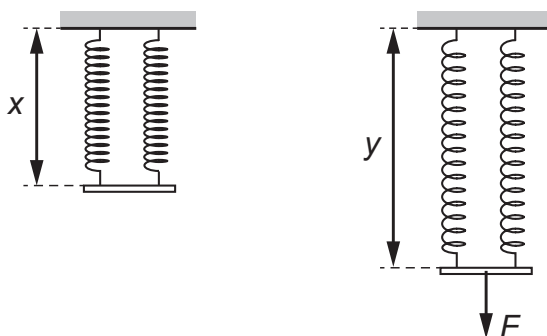


What can be deduced from the graph?

- A** The rubber band does **not** return to its original length when the force is decreased to zero.
- B** The rubber band obeys Hooke's law for the extensions shown.
- C** The rubber band remains elastic for the extensions shown.
- D** The shaded area represents the work done in extending the rubber band.

- 22** Two identical springs have the same spring constant k . The springs are connected in parallel. The length of the unstretched springs is x .

A force F is applied to the spring combination. The length of the springs is now y .



Both springs are deformed within their limits of proportionality.

Which expression gives the elastic potential energy stored in **one** of the springs?

- A** $\frac{1}{4}F(y - x)$
- B** $\frac{1}{2}F(y - x)$
- C** $\frac{1}{4}k(y - x)^2$
- D** $k(y - x)^2$

- 1 On a bench, a steel ball of radius r is used to compress a spring by a distance x . The ball is held at rest in this position, as shown in Fig. 1.1.

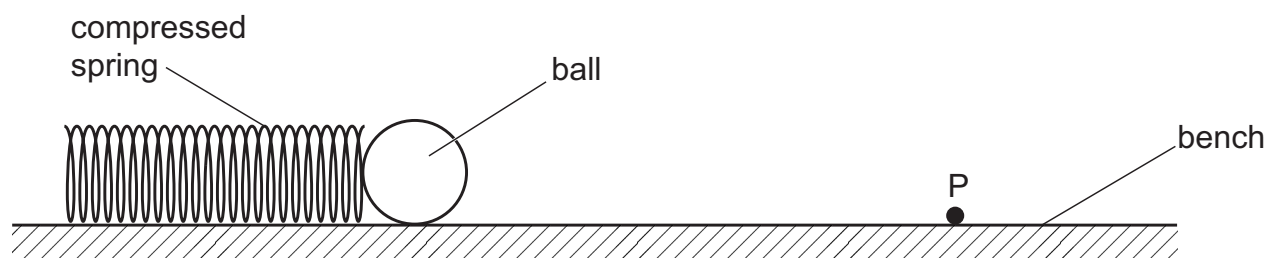


Fig. 1.1

The ball is released and rolls along the bench. At a fixed point P, the ball has speed v . The speed of the ball at P is determined using **one** light gate connected to a timer.

Several steel balls of different radii are available.

It is suggested that v is related to r by the relationship

$$v^2 = \frac{Ykx^2}{r^n\rho}$$

where k is the spring constant of the spring, ρ is the density of the steel, and Y and n are constants.

Plan a laboratory experiment to test the relationship between v and r .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for Y and n .

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.

Diagram

[illegible]

20 What are the units of stress, strain and the Young modulus?

	stress	strain	Young modulus
A	newton	metre	pascal
B	newton	no unit	newton
C	pascal	metre	newton
D	pascal	no unit	pascal

5 (a) Define the Young modulus.

.....
..... [1]

(b) A wire of unstretched length 0.81 m is made of a metal with Young modulus 95 GPa. The wire obeys Hooke's law and has a constant cross-sectional area. Fig. 5.1 shows the force–extension graph for the wire.

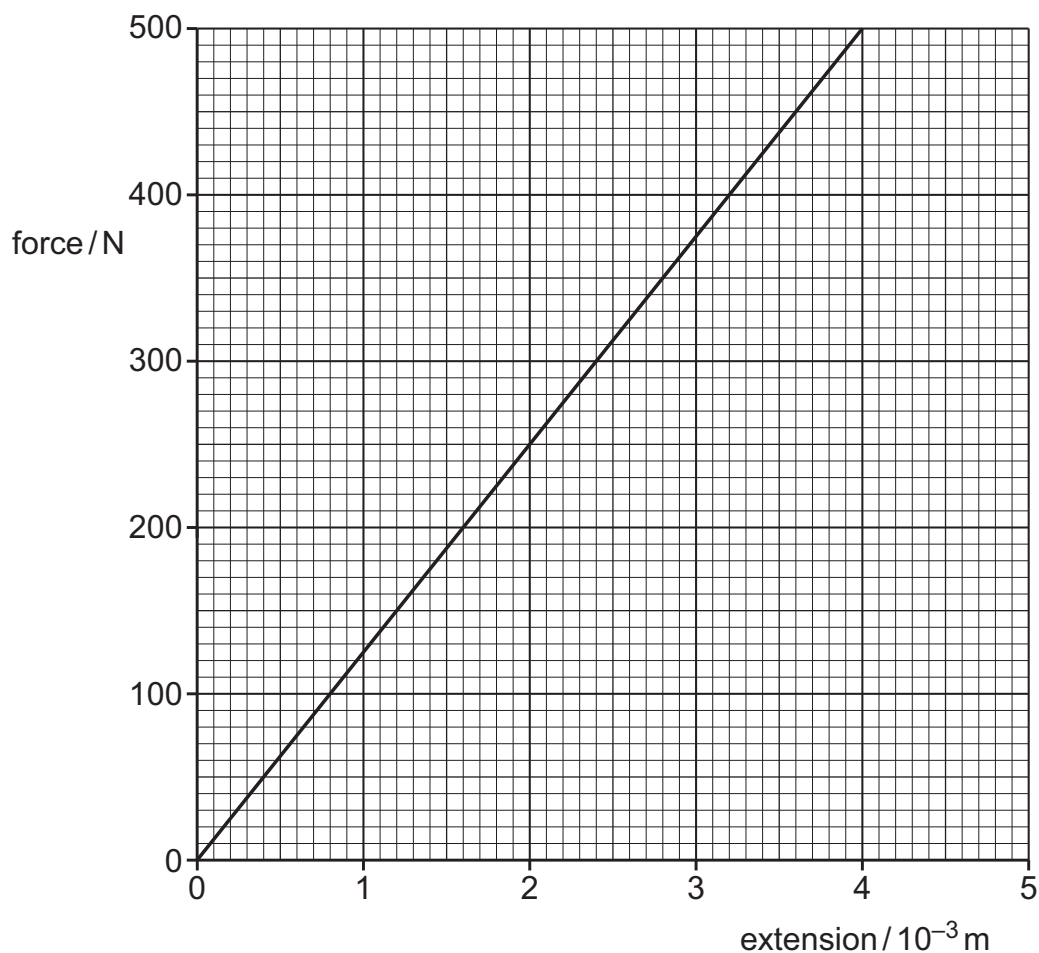


Fig. 5.1

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

area = m^2 [3]

(ii) The extension of the wire is initially $2.0 \times 10^{-3} \text{ m}$.

Determine the work done to increase the extension of the wire to $3.0 \times 10^{-3} \text{ m}$.

work done = J [3]

[Total: 7]

4 (a) Define the Young modulus of a material.

.....
..... [1]

(b) A metal wire P that obeys Hooke’s law is stretched within its limit of proportionality.

(i) On Fig. 4.1, sketch the variation of tensile force F in the wire with its extension x .

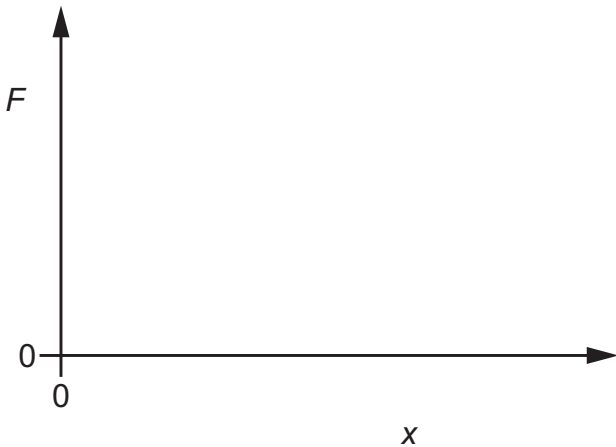


Fig. 4.1

(ii) State the name of the quantity represented by the gradient of the line in Fig. 4.1.

..... [1]

(iii) State the name of the quantity represented by the area under the line in Fig. 4.1.

..... [1]

(c) Another wire Q is made from a metal that has twice the Young modulus of the metal of wire P in (b). Wire Q has the same volume as wire P but has double the cross-sectional area of wire P.

The two wires are extended by equal tensile forces within their limits of proportionality.

State and explain how the extension of wire Q compares with the extension of wire P.

.....
.....
.....
.....
..... [3]