Deformation of Materials - 1

Exercise A

$g = 9.8\,\text{m s}^{-2}$

1 A steel spring has a spring constant of $25\,\text{N m}^{-1}$. Calculate:

   a the extension of the spring when the tension in it is equal to 10 N,

   b the tension in the spring when it is extended by 0.50 m from its unstretched length.

2 Two identical steel springs of length 250 mm are suspended vertically side-by-side from a fixed point. A 40 N weight is attached to the ends of the two springs. The length of each spring is then 350 mm. Calculate:

   a the tension in each spring,

   b the extension of each spring,

   c the spring constant of each spring.

3 Repeat 2a and b for the two springs in 'series' and vertical.

4 An object of mass 0.150 kg is attached to the lower end of a vertical spring of unstretched length 300 mm, which is fixed at its upper end. With the object at rest, the length of the spring becomes 420 mm as a result. Calculate:

   a the spring constant,

   b the energy stored in the spring,

   c the weight that needs to be added to extend the spring to 600 mm.

Exercise B

1 Calculate the stress in a wire of diameter 0.25 mm when the tension in the wire is 50 N.

2 A metal wire of diameter 0.23 mm and of unstretched length 1.405 m was suspended vertically from a fixed point. When a 40 N weight was suspended from the lower end of the wire, the wire stretched by an extension of 10.5 mm. Calculate the Young modulus of the wire material.

3 A vertical steel wire of length 2.5 m and diameter 0.35 mm supports a weight of 90 N. Calculate:

   a the stress in the wire,

   b the extension of the wire.
   The Young modulus of steel $= 2.1 \times 10^{11}$ Pa.

Exercise C

The Young modulus for
steel $= 2.1 \times 10^{11}$ Pa
copper $= 1.3 \times 10^{11}$ Pa

1 A vertical steel cable of diameter 24 mm and of length 18 m supports a weight of 1500 N attached to its lower end. Calculate a the tensile stress in the cable, b the extension of the cable, c the elastic energy stored in the cable, assuming its elastic limit has not been reached.

2 A vertical steel wire of diameter 0.28 mm and of length 2.0 m is fixed at its upper end, and has a weight of 15 N suspended from its lower end. Calculate a the extension of the wire, b the elastic energy stored in the wire.