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

....

....[1]

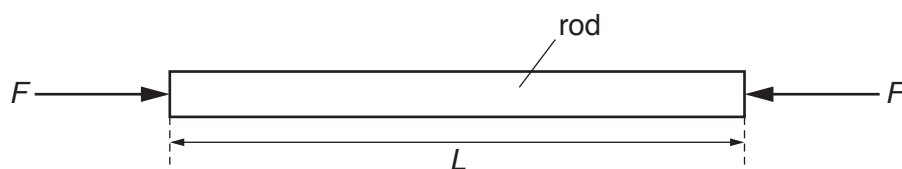**(b)** A metal rod is compressed, as shown in Fig. 4.1.

Fig. 4.1

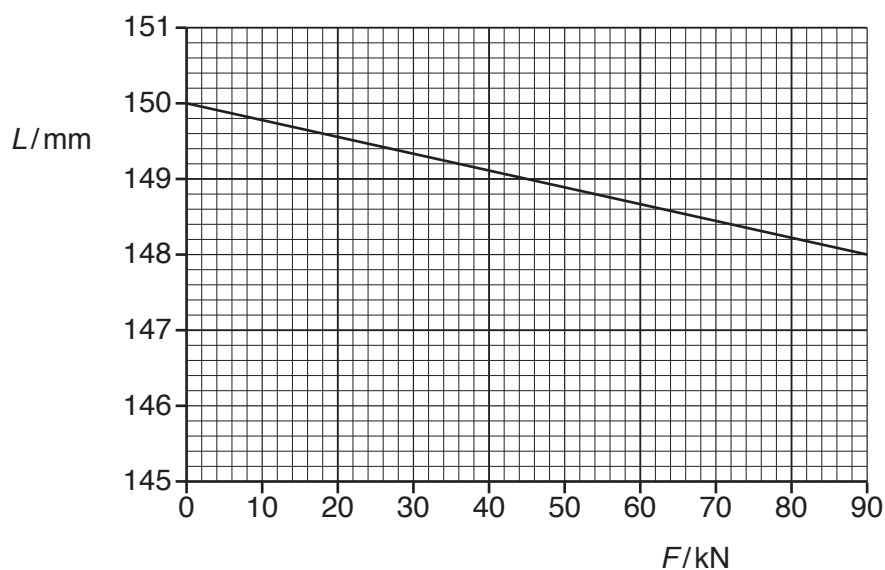The variation with compressive force *F* of the length *L* of the rod is shown in Fig. 4.2.

Fig. 4.2

Fig. 4.2 to

(i) determine the spring constant *k* of the rod,

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

(ii) determine the strain energy stored in the rod for $F = 90\,$kN.

strain energy = ... J [3]

(c) The rod in **(b)** has cross-sectional area A and is made of metal of Young modulus E. It is now replaced by a new rod of the same original length. The new rod has cross-sectional area $A/3$ and is made of metal of Young modulus $2E$. The compression of the new rod obeys Hooke's law.

On Fig. 4.2, sketch the variation with F of the length L for the new rod from $F = 0$ to $F = 90\,$kN.

[2]

[Total: 8]