3 **(a)** A uniform metal bar, initially unstretched, has sides of length *w*, *x* and *y*, as shown in Fig. 3.1.

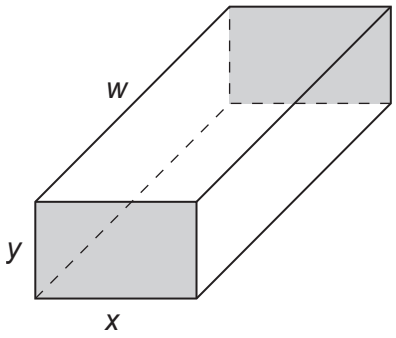

Fig. 3.1

The bar is now stretched by a tensile force *F* applied to the shaded ends. The changes in the lengths *x* and *y* are negligible. The bar now has sides of length *x*, *y* and *z*, as shown in Fig. 3.2.

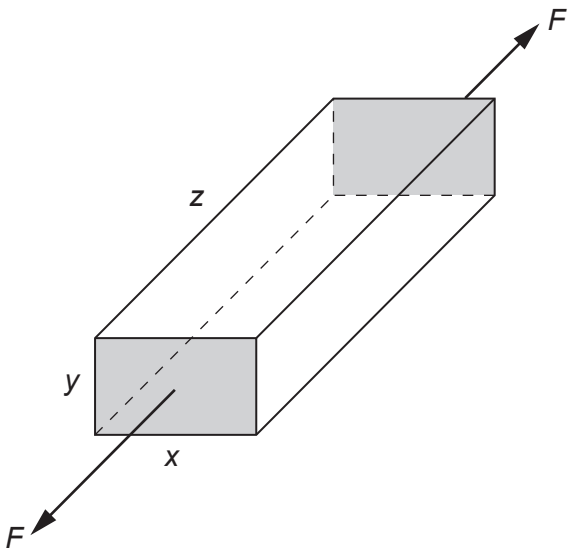

Fig. 3.2

Determine expressions, in terms of some or all of *F*, *w*, *x*, *y* and *z*, for:

(i) the stress σ applied to the bar by the tensile force

σ = ... [1]

(ii) the strain ε in the bar due to the tensile force

ε = ... [1]

(iii) the Young modulus *E* of the metal from which the bar is made.

E = ... [2]

(b) A copper wire is stretched by a tensile force that gradually increases from 0 to 280 N. The variation with extension of the tensile force is shown in Fig. 3.3.

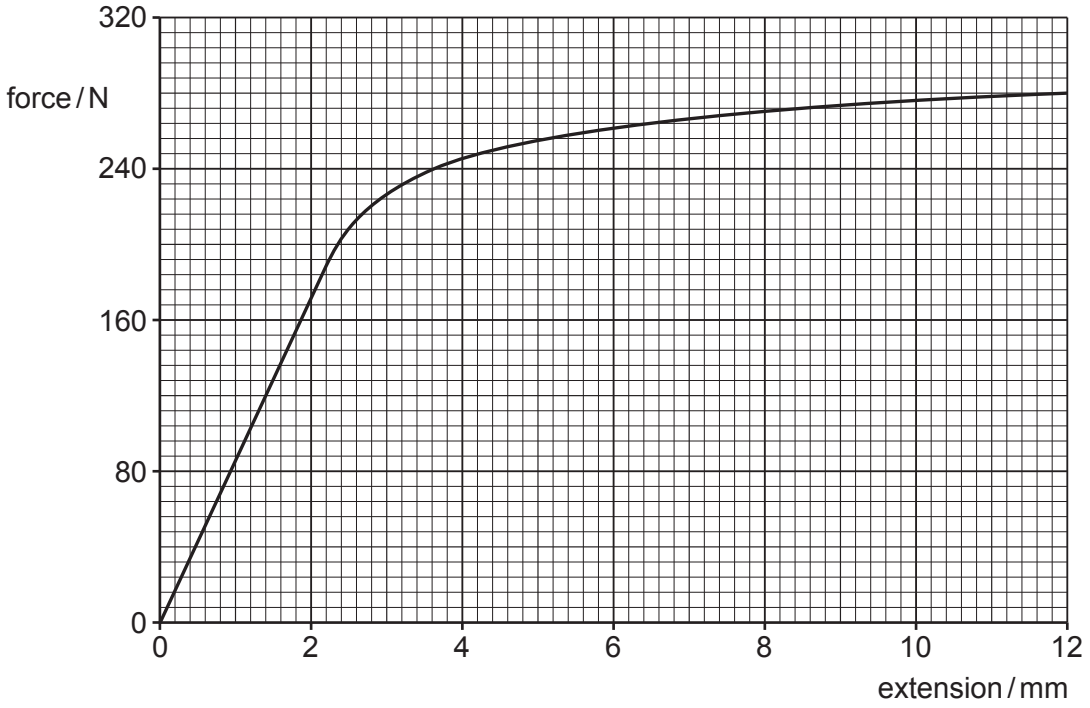

Fig. 3.3

(i) State the maximum extension of the wire for which it obeys Hooke's law.

extension = ... mm [1]

(ii) Fig. 3.3 to determine the strain energy in the wire when the tensile force is 120 N.

strain energy = ... J [3]

(iii) Explain why the work done in stretching the wire to an extension of 12 mm is not equal to the energy recovered when the tensile force is removed.

.....

.....

..... [2]

[Total: 10]