4 **(a)** Define, for a wire:

(i) *stress*

.....

..... [1]

(ii) *strain*.

.....

..... [1]

(b) **(i)** A school experiment is performed on a metal wire to determine the Young modulus of the metal. A force is applied to one end of the wire which is fixed at the other end. The variation of the force F with extension x of the wire is shown in Fig. 4.1.

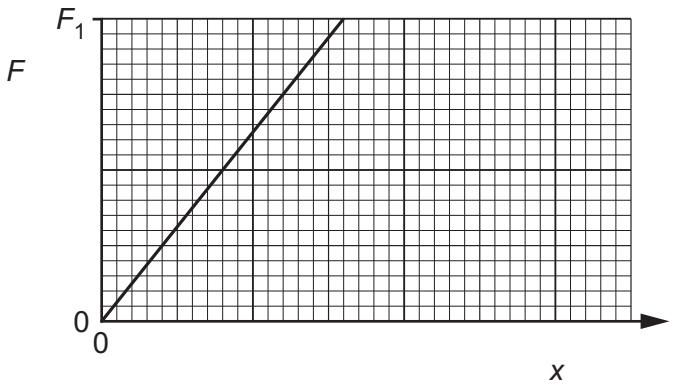

Fig. 4.1

The maximum force applied to the wire is F_1.

The gradient of the graph line in Fig. 4.1 is G. The wire has initial length L and cross-sectional area A.

Determine an expression, in terms of A, G and L, for the Young modulus E of the metal.

E = ... [2]

(ii) A student repeats the experiment in **(b)(i)** using a new wire that has twice the diameter of the first wire. The initial length of the wire and the metal of the wire are unchanged.

On Fig. 4.1, draw the graph line representing the new wire for the force increasing from $F = 0$ to $F = F_1$. [2]

(iii) Another student repeats the original experiment in **(b)(i)**, increasing the force beyond F_1 to a new maximum force F_2. The new graph obtained is shown in Fig. 4.2.

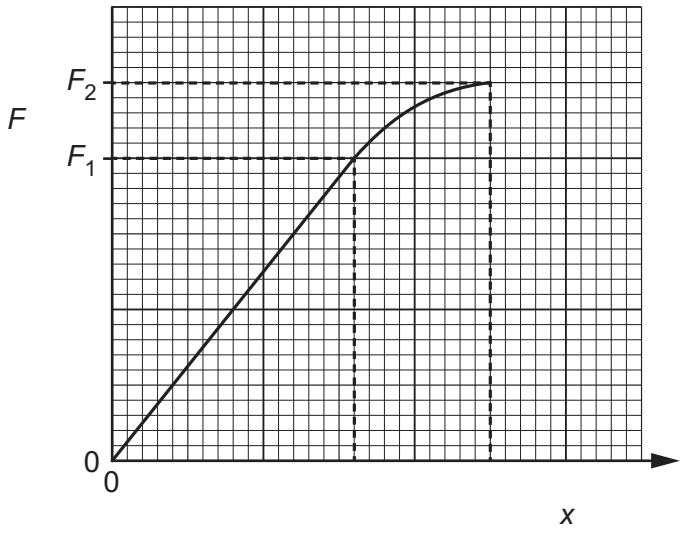

Fig. 4.2

1. On Fig. 4.2, shade an area that represents the work done to extend the wire when the force is increased from F_1 to F_2. [1]

2. Explain how the student can check that the elastic limit of the wire was not exceeded when force F_2 was applied.

.....

.....

..... [1]

(iv) Each student in the class performs the experiment in **(b)(i)**. The teacher describes the values of the Young modulus calculated by the students as having high accuracy and low precision.

Explain what is meant by *low precision*.

.....

..... [1]

[Total: 9]