3 A wire has length L and cross-sectional area A. The wire is made from a metal that has Young modulus E and resistivity ρ.

(a) Define the Young modulus of a material.

.....

..... [1]

(b) **(i)** State an expression, in terms of some or all of L, A, E and ρ, for the resistance R_0 of the wire.

R_0 = ... [1]

(ii) Show that the spring constant k_0 of the wire is given by

$$k_0 = \frac{EA}{L}.$$

[2]

(d) Copper has a resistivity of $1.8 \times 10^{-8}\,\Omega\,\text{m}$ and a Young modulus of $1.3 \times 10^{11}\,\text{Pa}$.

A copper wire of diameter 1.6 mm has a resistance of $0.034\,\Omega$.

(i) Show that the length of the wire is 3.8 m.

[1]

(ii) Use the equation in **(b)(ii)** to determine the spring constant of the wire.

spring constant = ... N m^{-1} [2]

[Total: 9]