Task. If a force of $F = 80$ N extends a spring of natural length $L = 8$ m by $\Delta L = 0.4$ m, what will be the length of the spring when the applied force is $F_1 = 100$ N.

Solution. Recall that Hooke's law claims that the force F needed to extend a spring by distance ΔL is proportional to ΔL:

$$F = k\,\Delta L,$$

where k is a constant coefficient called stiffness of a spring.

In our case

$$\Delta L = 0.4\ m, \qquad F = 80\,N$$

Suppose we apply the force $F_1 = 100$ N. Then

$$F_1 = k\Delta L_2,$$

whence

$$k = \frac{F}{\Delta L} = \frac{F_1}{\Delta L_1},$$

and therefore

$$\Delta L_1 = \frac{F_1}{F}\Delta L.$$

Hence the length L of the spring will be

$$L = L_0 + \Delta L_1 = L_0 + \frac{F_1}{F}\Delta L.$$

Substituting values we get:

$$L = 8 + \frac{100}{80} \cdot 0.4 = 8 + \frac{40}{80} = 8.5\ m.$$