Physics I

Elasticity

$\Delta L = \dfrac{FL}{EA}$ (the "flea" equation)

Problem 1.- A steel cable 12 m long and has a diameter of 8mm. Calculate how much it will stretch under a tension of 4500 N.
[Young's modulus of steel = 200×10^9 N/m^2]

Solution: The area of the cross section is: $A = \pi R^2 = \pi(0.004m)^2$

The other values of the "flea" equation are given in the problem so:

$$\Delta L = \frac{FL}{EA} = \frac{(4500N)(12m)}{(200\times10^9 N/m^2)\left[\pi\times(0.004m)^2\right]} = \textbf{5.4 mm}$$

Problem 1a.- Calculate the elongation of a steel cable 12m long with a diameter of 16mm under a 450kg load. [Young's modulus of steel E = 200×10^9 N/m^2]

Note: The area of a circle is $A = \dfrac{\pi D^2}{4}$, where D is the diameter.

Solution: This problem shows the use of the "Flea equation", all you need to do is substitute the correct numbers in the equation:

$$\Delta L = \frac{FL}{EA} = \frac{mgL}{E\left(\dfrac{\pi D^2}{4}\right)} = \frac{450\times9.8\times12}{200\times10^9\left(\dfrac{\pi(0.016)^2}{4}\right)} = \textbf{0.0013 m}$$