

Answer on Question #53642, Physics / Other

Task: Calculate the tensile force required to produce an elongation of 0.1 percent in a wire of radius 0.5 mm. (The Young's modulus of the material of the wire is $1.0 \times 10^{11} \text{ N m}^{-2}$)

Answer:

L – length of wire.

$$r = 0.5 \text{ mm}$$

$$Y = 1.0 \cdot 10^{11} \text{ N} \cdot \text{m}^{-2}$$

$$A = \pi r^2 = \pi (0.5 \cdot 10^{-3} \text{ m})^2 = 25\pi \cdot 10^{-8} \text{ m}^2$$

$$\text{Stress} = \frac{F}{A} = \frac{F}{25\pi \cdot 10^{-8} \text{ m}^2};$$

$$\text{Strain} = \frac{\Delta L}{L_0} = \frac{0.001L}{L} = 0.001$$

$$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\frac{F}{25\pi \cdot 10^{-8} \text{ m}^2}}{0.001} \Rightarrow F = Y \cdot 0.001 \cdot 25\pi \cdot 10^{-8} \text{ m}^2 = 10^{11} \text{ N} \cdot \text{m}^2 \cdot 0.001 \cdot 25\pi \cdot 10^{-8} \text{ m}^2 \approx 78.5 \text{ N}$$