

Physics 101 Rec
Quiz # 13c

Instructor: Dr. A. Mekki

Name:

Key

Id:

Sect:

- (a) Find the maximum diameter of a steel wire 18 m long that will elongate no more than 9.0 mm when a load of 380 kg is hung on the lower end. Young modulus of steel is 2.0×10^{11} N/m².

$$\frac{F}{A} = E \frac{\Delta L}{L}$$

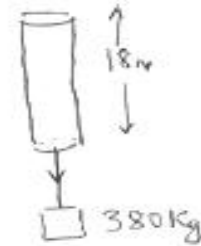
$$F = mg = 380 \times 9.8 = 3724 \text{ N}$$

$$A = \pi R^2$$

$$\Delta L = 9 \times 10^{-3} \text{ m} \quad L = 18 \text{ m}$$

$$\Rightarrow \pi r^2 = \frac{F}{E \frac{\Delta L}{L}} = \frac{3724}{2 \times 10^{11} \times \frac{9 \times 10^{-3}}{18}} = 3.72 \times 10^{-5} \text{ m}^2$$

$$r = 3.44 \times 10^{-3} \text{ m}$$



- (b) If the yield strength of this steel wire is 3.0×10^8 N/m², will permanent deformation occur?

$$\frac{F}{A} = \frac{3724}{\pi (3.44 \times 10^{-3})^2} = 1.0 \times 10^8 \text{ N/m}^2$$

Since $\frac{F}{A} < S_y = 3.0 \times 10^8 \Rightarrow$ there will be no permanent deformation.