## 53.

## Problem 13.47E (HRW)

After a fall, a 95 kg rock climber finds himself dangling from the end of a rope that had been 15 m long and 9.6 mm in diameter but which has stretched by 2.8 cm . We have to calculate for the rope (a) strain, (b) stress and (c) Young's modulus.

## Solution:

(a)

Strain $=\frac{\Delta l}{l}=\frac{2.8 \times 10^{-2} \mathrm{~m}}{15 \mathrm{~m}}=1.86 \times 10^{-3}$.
Force on the rope, $F=95 \times 9.8 \mathrm{~kg} \mathrm{~m} \mathrm{~s}^{-2}=931 \mathrm{~N}$.
(b)

Stress $=\frac{F}{A}=\frac{931 \mathrm{~N}}{\pi \times\left(4.8 \times 10^{-3}\right)^{2} \mathrm{~m}^{2}}=1.28 \times 10^{7} \mathrm{~N} \mathrm{~m}^{-2}$.
(c)

Young's modulus, $E$,

$$
E=\frac{\text { stress }}{\text { strain }}=\frac{1.28 \times 10^{7} \mathrm{~N} \mathrm{~m}^{-2}}{1.86 \times 10^{-3}}=6.88 \times 10^{9} \mathrm{~N} \mathrm{~m}^{-2} .
$$



