Answer on Question #60362-Physics-Other

The fundamental frequency of a 1.5m long, stretched steel wire is 175Hz.

(i) Calculate the speed of transverse waves and the longitudinal stress in the wire.

(ii) If the tension in the wire is increased by 3%, calculate the percentage change in the frequency of the wire. Density of steel= 7.8*103 kg/m3.

Solution

(i)

$$n = \frac{1}{2l}\sqrt{\frac{T}{m}} = \frac{1}{2l}\sqrt{\frac{T}{A\rho}} = \frac{v}{2l}$$

$$v = 2nl = 2(175)(1.5) = 525\frac{m}{s}$$

$$v = \sqrt{\frac{T}{A\rho}}$$

$$Stress = \frac{T}{A} = \rho v^2 = 7.8 \cdot 10^3 \, (525)^2 = 2.15 \cdot 10^9 Pa$$

(ii)

$$\frac{\Delta n}{n}100\% = \frac{\sqrt{1.03}n - n}{n}100\% = 1.5\%.$$