Answer on Question #66035, Physics / Mechanics | Relativity

A sonometer wire having cross-sectional area 0.85 ´ 10^{-6} m^2 is stretched between two rigid supports 1.2 m apart. A tension of 20 N is applied at its free end. If the temperature is reduced by 12°C, calculate the final tension in the wire. Take coefficient of linear expansion (a) and isothermal Young's modulus (g) to be 1.5 ´ 10^{-5} K^{-1} and 2.0 ´ 10^{11} Nm^{-2}, respectively.

Solution:

When dL = 0, we using the next equation

$$dF = -A\gamma\alpha dT$$

Integrating this equation

$$\int_{F_1}^{F_2} dF = -A\gamma\alpha \int_{T_1}^{T_2} dT$$

We get

$$F_2 - F_1 = A\gamma\alpha\ (T_1 - T_2)$$

Let T_1 = 20 °C

$$F_2 - F_1 = 0.85 \cdot 10^{-6} m^2 \times 1.5 \cdot 10^{-5} K^{-1} \times 2.0 \cdot 10^{11} Nm^{-2} \times 8\ K$$

$$F_2 - F_1 = 20.4\ N$$

So that

$$F_2 = 20.4\ N + 20\ N = 40.4\ N$$

Answer: 40.4 N