

25. Consider half the bar. Its original length is $\ell_0 = L_0/2$ and its length after the temperature increase is $\ell = \ell_0 + \alpha \ell_0 \Delta T$. The old position of the half-bar, its new position, and the distance x that one end is displaced form a right triangle, with a hypotenuse of length ℓ , one side of length ℓ_0 , and the other side of length x . The Pythagorean theorem yields $x^2 = \ell^2 - \ell_0^2 = \ell_0^2(1 + \alpha \Delta T)^2 - \ell_0^2$. Since the change in length is small we may approximate $(1 + \alpha \Delta T)^2$ by $1 + 2\alpha \Delta T$, where the small term $(\alpha \Delta T)^2$ was neglected. Then,

$$x^2 = \ell_0^2 + 2\ell_0^2 \alpha \Delta T - \ell_0^2 = 2\ell_0^2 \alpha \Delta T$$

and

$$x = \ell_0 \sqrt{2\alpha \Delta T} = \frac{3.77 \text{ m}}{2} \sqrt{2(25 \times 10^{-6} / \text{C}^\circ)(32 \text{ C}^\circ)} = 7.5 \times 10^{-2} \text{ m} .$$