

18. The change in length for the section of the steel ruler between its 20.05 cm mark and 20.11 cm mark is

$$\Delta L_s = L_s \alpha_s \Delta T = (20.11 \text{ cm})(11 \times 10^{-6}/\text{C}^\circ)(270^\circ\text{C} - 20^\circ\text{C}) = 0.055 \text{ cm} .$$

Thus, the actual change in length for the rod is  $\Delta L = (20.11 \text{ cm} - 20.05 \text{ cm}) + 0.055 \text{ cm} = 0.115 \text{ cm}$ . The coefficient of thermal expansion for the material of which the rod is made of is then

$$\alpha = \frac{\Delta L}{\Delta T} = \frac{0.115 \text{ cm}}{270^\circ\text{C} - 20^\circ\text{C}} = 23 \times 10^{-6}/\text{C}^\circ .$$