

100. The initial volume  $V_0$  of the liquid is  $h_0 A_0$  where  $A_0$  is the initial cross-section area and  $h_0 = 0.64$  m. Its final volume is  $V = hA$  where  $h - h_0$  is what we wish to compute. Now, the area expands according to how the glass expands, which is we analyze as follows.

$$\begin{aligned} A &= \pi r^2 \\ dA &= 2\pi r dr \\ dA &= 2\pi r (r\alpha dT) \\ dA &= 2\alpha A dT \end{aligned}$$

Therefore, the height is

$$h = \frac{V}{A} = \frac{V_0 (1 + \beta_{\text{liquid}} \Delta T)}{A_0 (1 + 2\alpha_{\text{glass}} \Delta T)} .$$

Thus, with  $V_0/A_0 = h_0$  we obtain

$$\begin{aligned} h - h_0 &= h_0 \left( \frac{1 + \beta_{\text{liquid}} \Delta T}{1 + 2\alpha_{\text{glass}} \Delta T} - 1 \right) \\ &= (0.64) \left( \frac{1 + (4 \times 10^{-5}) (10^\circ)}{1 + 2 (1 \times 10^{-5}) (10^\circ)} \right) \\ &= 1.3 \times 10^{-4} \text{ m} . \end{aligned}$$