

16

①

At  $12.25^\circ\text{C}$  a brass sleeve has an inside diameter of  $2.19625\text{cm}$  and a steel shaft has a diameter of  $2.19893\text{cm}$ . The sleeve is to be shrink-fit over the shaft.

- (1) How hot must the sleeve be if the steel is not heated?
- (2) How cool must the shaft be if the sleeve is not cooled?

(1)

$$\alpha_{\text{brass}} = 19 \times 10^{-6} \frac{1}{\text{K}}$$

diameter  $\Rightarrow$  length

$$\Delta L = L_0 \alpha \Delta T$$

$$T_f = \frac{\Delta L}{L_0 \alpha} + T_i$$

$$= \frac{2.19893\text{cm} - 2.19625\text{cm}}{2.19625\text{cm} (19 \times 10^{-6} \frac{1}{\text{C}})} +$$

$$12.25^\circ\text{C}$$

$$T_f = 76.47^\circ C$$

(2)  $\alpha_{steel} = 12E-6 \frac{1}{K}$

$$T_f = \frac{\Delta L}{L_0 \alpha} + T_i$$

$$= \frac{2.19625 \text{ cm} - 2.19893 \text{ cm}}{2.19893 \text{ cm} (12E-6 \frac{1}{K})} + 12.25$$

$$z = -89.31^\circ C$$