19.26 (a) We are asked to compute the magnitude of the stress within a brass rod that is heated while its ends are maintained rigid. To do this we employ Equation 19.8, using a value of 97 GPa for the modulus of elasticity of brass (Table 6.1), and a value of 20.0 x 10^{-6} $(°C)^{-1}$ for α_l (Table 19.1). Therefore

$$\sigma = E\alpha_l(T_0 - T_f)$$

$$= (97 \times 10^3 \text{ MPa})\left[20.0 \times 10^{-6}(°C)^{-1}\right](15°C - 85°C)$$

$$= -136 \text{ MPa} \quad (-20{,}000 \text{ psi})$$

The stress will be compressive since its sign is negative.

(b) The stress will be the same [–136 MPa (–20,000 psi)], since stress is independent of bar length.

(c) Upon cooling the indicated amount, the stress becomes

$$\sigma = E\alpha_l(T_0 - T_f)$$

$$= (97 \times 10^3 \text{ MPa})\left[20.0 \times 10^{-6}(°C)^{-1}\right][(15°C - (-15°C)]$$

$$= +58 \text{ MPa} \quad (+8400 \text{ psi})$$

This stress will be tensile since its sign is positive.