7.41 This problem calls for us to calculate the yield strength of a brass specimen after it has been heated to an elevated temperature at which grain growth was allowed to occur; the yield strength (150 MPa) was given at a grain size of 0.01 mm. It is first necessary to calculate the constant k_y in Equation 7.7 as

$$k_y = \frac{\sigma_y - \sigma_0}{d^{-1/2}}$$

$$= \frac{150\ \text{MPa} - 25\ \text{MPa}}{(0.01\ \text{mm})^{-1/2}} = 12.5\ \text{MPa} - \text{mm}^{1/2}$$

Next, we must determine the average grain size after the heat treatment. From Figure 7.25 at 500°C after 1000 s (16.7 min) the average grain size of a brass material is about 0.016 mm. Therefore, calculating σ_y at this new grain size using Equation 7.7 we get

$$\sigma_y = \sigma_0 + k_y d^{-1/2}$$

$$= 25\ \text{MPa} + \left(12.5\ \text{MPa} \cdot \text{mm}^{1/2}\right)(0.016\ \text{mm})^{-1/2} = 124\ \text{MPa}\ \ (18{,}000\ \text{psi})$$