13.14 This problem calls for us to determine the maximum temperature to which a cylindrical specimen of borosilicate glass may be heated in order that its deformation be less than 2.5 mm over a week's time. According to Equation 6.1

$$\sigma = \frac{F}{A_0} = \frac{2 \text{ N}}{\pi\left(\frac{4 \text{ x } 10^{-3} \text{ m}}{2}\right)^2} = 1.59 \text{ x } 10^5 \text{ Pa}$$

Also,

$$\frac{d\varepsilon}{dt} = \frac{d\left(\frac{\Delta l}{l_0}\right)}{dt}$$

$$= \frac{2.5 \text{ mm}/125 \text{ mm}}{(1 \text{ wk})(7 \text{ days/week})(24 \text{ h/day})(3600 \text{ s/h})} = 3.31 \text{ x } 10^{-8} \text{ s}^{-1}$$

Thus,

$$\eta = \frac{\sigma}{d\varepsilon/dt} = \frac{1.59 \text{ x } 10^5 \text{ Pa}}{3.31 \text{ x } 10^{-8} \text{ s}^{-1}} = 4.8 \text{ x } 10^{12} \text{ Pa - s}$$

From Figure 13.7, the temperature at which the viscosity of the borosilicate glass is 4.8 x 10^{12} Pa-s is about 540°C (1005°F).