

8.34 This problem gives  $\dot{\epsilon}_s$  values at two different stress levels and 200°C, and the activation energy for creep, and asks that we determine the steady-state creep rate at 250°C and 48 MPa (7000 psi).

Taking natural logarithms of both sides of Equation 8.20 yields

$$\ln \dot{\epsilon}_s = \ln K_2 + n \ln \sigma - \frac{Q_c}{RT}$$

With the given data there are two unknowns in this equation--namely  $K_2$  and  $n$ . Using the data provided in the problem statement we can set up two independent equations as follows:

$$\ln(2.5 \times 10^{-3} \text{ h}^{-1}) = \ln K_2 + n \ln(55 \text{ MPa}) - \frac{140,000 \text{ J/mol}}{(8.31 \text{ J/mol} \cdot \text{K})(473 \text{ K})}$$

$$\ln(2.4 \times 10^{-2} \text{ h}^{-1}) = \ln K_2 + n \ln(69 \text{ MPa}) - \frac{140,000 \text{ J/mol}}{(8.31 \text{ J/mol} \cdot \text{K})(473 \text{ K})}$$

Now, solving simultaneously for  $n$  and  $K_2$  leads to  $n = 9.97$  and  $K_2 = 3.27 \times 10^{-5} \text{ h}^{-1}$ . Thus it is now possible to solve for  $\dot{\epsilon}_s$  at 48 MPa and 523 K using Equation 8.20 as

$$\begin{aligned} \dot{\epsilon}_s &= K_2 \sigma^n \exp\left(-\frac{Q_c}{RT}\right) \\ &= (3.27 \times 10^{-5} \text{ h}^{-1})(48 \text{ MPa})^{9.97} \exp\left[-\frac{140,000 \text{ J/mol}}{(8.31 \text{ J/mol} \cdot \text{K})(523 \text{ K})}\right] \\ &= 1.94 \times 10^{-2} \text{ h}^{-1} \end{aligned}$$