12.49 (a) Given the flexural strengths at two different volume fraction porosities, we are asked to determine the flexural strength for a nonporous material. If the natural logarithm is taken of both sides of Equation 12.10, then

$$\ln \sigma_{fs} = \ln \sigma_0 - nP$$

Using the data provided in the problem statement, two simultaneous equations may be written as

$$\ln (70 \text{ MPa}) = \ln \sigma_0 - (0.10)\, n$$

$$\ln (60 \text{ MPa}) = \ln \sigma_0 - (0.15)\, n$$

Solving for n and σ_0 leads to $n = 3.08$ and $\sigma_0 = 95.3$ MPa. For the nonporous material, $P = 0$, and, from Equation 12.10, $\sigma_0 = \sigma_{fs}$. Thus, σ_{fs} for $P = 0$ is 95.3 MPa.

(b) Now, we are asked for σ_{fs} at $P = 0.20$ for this same material. Utilizing Equation 12.10 yields

$$\sigma_{fs} = \sigma_0 \exp(-nP)$$

$$= (95.3 \text{ MPa}) \exp\left[-(3.08)(0.20)\right]$$

$$= 51.5 \text{ MPa}$$