12.48 (a) This part of the problem asks us to determine the flexural strength of nonporous MgO assuming that the value of n in Equation 12.10 is 3.75. Taking natural logarithms of both sides of Equation 12.10 yields

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

In Table 12.5 it is noted that for $P = 0.05$, $\sigma_{fs} = 105$ MPa. For the nonporous material $P = 0$ and, $\ln \sigma_0 = \ln \sigma_{fs}$. Solving for $\ln \sigma_0$ from the above equation and using these data gives

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

$$= \ln (105 \text{ MPa}) + (3.75)(0.05) = 4.841$$

or $\sigma_0 = e^{4.841} = 127$ MPa (18,100 psi).

(b) Now we are asked to compute the volume percent porosity to yield a σ_{fs} of 74 MPa (10,700 psi). Taking the natural logarithm of Equation 12.10 and solving for P leads to

$$P = \frac{\ln \sigma_0 - \ln \sigma_{fs}}{n}$$

$$= \frac{\ln (127 \text{ MPa}) - \ln (74 \text{ MPa})}{3.75}$$

$$= 0.144 \text{ or } 14.4 \text{ vol\%}$$