12.46  (a)  This portion of the problem requests that we compute the modulus of elasticity for nonporous spinel given that \( E = 240 \text{ GPa} \) for a material having 5 vol% porosity. Thus, we solve Equation 12.9 for \( E_0 \), using \( P = 0.05 \), which gives

\[
E_0 = \frac{E}{1 - 1.9P + 0.9P^2}
\]

\[
= \frac{240 \text{ GPa}}{1 - (1.9)(0.05) + (0.9)(0.05)^2} = 265 \text{ GPa} \quad (38.6 \times 10^6 \text{ psi})
\]

(b) Now we are asked to determine the value of \( E \) at \( P = 15 \text{ vol\%} \) (i.e., 0.15). Using Equation 12.9 we get

\[
E = E_0 \left(1 - 1.9P + 0.9P^2\right)
\]

\[
= (265 \text{ GPa}) \left[1 - (1.9)(0.15) + (0.09)(0.15)^2\right] = 195 \text{ GPa} \quad (28.4 \times 10^6 \text{ psi})
\]