16.12 (a) Given some data for an aligned and continuous carbon-fiber-reinforced nylon 6,6 composite, we are asked to compute the volume fraction of fibers that are required such that the fibers carry 97% of a load applied in the longitudinal direction. From Equation 16.11

$$\frac{F_f}{F_m} = \frac{E_f V_f}{E_m V_m} = \frac{E_f V_f}{E_m (1 - V_f)}$$

Now, using values for F_f and F_m from the problem statement

$$\frac{F_f}{F_m} = \frac{0.97}{0.03} = 32.3$$

And when we substitute the given values for E_f and E_m into the first equation leads to

$$\frac{F_f}{F_m} = 32.3 = \frac{(260\ \text{GPa}) V_f}{(2.8\ \text{GPa})(1 - V_f)}$$

And, solving for V_f yields, $V_f = 0.258$.

(b) We are now asked for the tensile strength of this composite. From Equation 16.17,

$$\sigma_{cl}^{*} = \sigma_m^{'}(1 - V_f) + \sigma_f^{*} V_f$$

$$= (50\ \text{MPa})(1 - 0.258) + (4000\ \text{MPa})(0.258)$$

$$= 1070\ \text{MPa}\ \ (155{,}000\ \text{psi})$$

since values for σ_f^{*} (4000 MPa) and $\sigma_m^{'}$ (50 MPa) are given in the problem statement.