

16.8 A continuous and aligned fiber-reinforced composite is to be produced consisting of 30 vol% aramid fibers and 70 vol% of a polycarbonate matrix; mechanical characteristics of these two materials are as follows:

|               | Modulus of Elasticity<br>[GPa (psi)] | Tensile Strength [MPa<br>(psi)] |
|---------------|--------------------------------------|---------------------------------|
| Aramid fiber  | 131 ( $19 \times 10^6$ )             | 3600 (520,000)                  |
| Polycarbonate | 2.4 ( $3.5 \times 10^5$ )            | 65 (9425)                       |

Also, the stress on the polycarbonate matrix when the aramid fibers fail is 45 MPa (6500 psi).

For this composite, compute

- (a) the longitudinal tensile strength, and
- (b) the longitudinal modulus of elasticity

#### Solution

This problem calls for us to compute the longitudinal tensile strength and elastic modulus of an aramid fiber-reinforced polycarbonate composite.

- (a) The longitudinal tensile strength is determined using Equation 16.17 as

$$\begin{aligned}
 \sigma_{cl}^* &= \sigma_m^* (1 - V_f) + \sigma_f^* V_f \\
 &= (45 \text{ MPa})(0.70) + (3600)(0.30) \\
 &= 1100 \text{ MPa (160,000 psi)}
 \end{aligned}$$

- (b) The longitudinal elastic modulus is computed using Equation 16.10a as

$$\begin{aligned}
 E_{cl} &= E_m V_m + E_f V_f \\
 &= (2.4 \text{ GPa})(0.70) + (131 \text{ GPa})(0.30) \\
 &= 41 \text{ GPa (} 5.95 \times 10^6 \text{ psi)}
 \end{aligned}$$