6.62. **Solve:** (a) The terminal velocity for a falling object is reached when the downward gravitational force is balanced by the upward drag force.

\[ F_G = D \]

\[ mg = bv_{term} = 6\pi\eta R v_{term} \]

\[ \Rightarrow v_{term} = \frac{mg}{6\pi\eta R} \]

(b) The mass of the spherical sand grain of density \( p = 2400 \text{ kg/m}^3 \) is \( m = \rho \left( \frac{4}{3}\pi R^3 \right) \).

Thus

\[ v_{term} = \frac{2\rho g R^2}{9\eta} = \frac{2}{9} \left( \frac{2400 \text{ kg/m}^3}{(9.80 \text{ m/s}^2)(5.0 \times 10^{-4} \text{ m})^2} \right) = 1.3 \text{ m/s} \]

The time required for the sand grain to fall 50 m at this speed is \( t = \frac{50 \text{ m}}{1.3 \text{ m/s}} = 38 \text{ s} \).

**Assess:** The speed of 1.3 m/s for a sand grain falling through water seems about right.