8.2 Water flows through a 50-ft pipe with a 0.5-in. diameter at 5 gal/min. What fraction of this pipe can be considered an entrance region?

Based on Tables 1.3 & 1.4

$$5 \; gal/min = 1.11 \times 10^{-2} \; ft^3/s$$

Determine Re

$$V = Q/A = \frac{1.11 \times 10^{-2}}{\frac{\pi}{4}\left(\frac{0.5}{12}\right)^2} = 8.17 \; ft/s$$

$$Re = \frac{VD}{\nu} = \frac{(8.17)\left(0.5/12\right)}{1.21 \times 10^{-5}} = 2.81 \times 10^4$$

For turbulent flow

$$\frac{\ell_e}{D} = 4.4(Re)^{1/6}$$

$$\ell_e = \left(0.5/12\right) 4.4 \left(2.81 \times 10^4\right)^{1/6}$$

$$\underline{\ell_e = 1.0 \; ft}$$