8.29 If the velocity profile for turbulent flow in a pipe is approximated by the power-law profile (Eq. 8.31), at what radial location should a Pitot tube be placed if it is to measure the average velocity in the pipe? Assume $n = 7, 8,$ or 9.

$$\frac{\bar{u}}{V_c} = \left(1 - \frac{r}{R}\right)^{\frac{1}{n}} \quad \text{and} \quad \frac{V}{V_c} = \frac{2n^2}{(n+1)(2n+1)} \quad \text{so that with } \bar{u} = V,$$

$$\left(1 - \frac{r}{R}\right)^{\frac{1}{n}} = \frac{2n^2}{(n+1)(2n+1)} \quad \text{or} \quad \frac{r}{R} = 1 - \left[\frac{2n^2}{(n+1)(2n+1)}\right]^n = \begin{cases} 0.758 \text{ if } n=7 \\ 0.760 \text{ if } n=8 \\ 0.762 \text{ if } n=9 \end{cases}$$