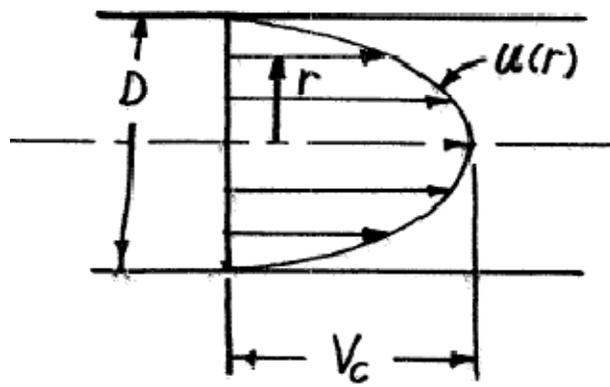


8.19 A viscous fluid flows in a 0.10-m-diameter pipe such that its velocity measured 0.012 m away from the pipe wall is 0.8 m/s. If the flow is laminar, determine the centerline velocity and the flowrate.

Solutions:

(1) Analysis of the problem shows that flow properties (no fluid name and temperature) are not needed, establish coordinates:



(2) Known: pipe diameter $D = 0.1m$; at $r = \frac{D}{2} - 0.012 = 0.038m$,

$$V(r) = 0.8m/s$$

(3) Compute centerline velocity:

$$V(r) = V_c \left[1 - \left(\frac{r}{r_0} \right)^2 \right] \quad \text{use the known conditions, we get}$$

$$V_c = 1.89m/s$$

(4) compute the flow rate:

$$Q = \frac{\pi}{4} D^2 \bar{V} = \frac{\pi}{4} D^2 (0.5V_c) = \frac{\pi}{4} (0.1m)^2 (0.5) \left(1.89 \frac{m}{s} \right) = 7.42 \times 10^{-3} \frac{m^3}{s}$$