

Chapter 15 Problem 36 †

Given

$$D_h = 10 \text{ cm} = 0.10 \text{ m}$$

$$D_n = 2.5 \text{ cm} = 0.025 \text{ m}$$

$$R = 15 \text{ kg/s}$$

Solution

a) Find the flow speed in the hose.

Flow rate through a cylindrical hose is given by

$$R = \rho v A = \rho v \pi \left(\frac{D}{2} \right)^2$$

Solving for velocity gives

$$v = \frac{R}{\rho \pi \left(\frac{D}{2} \right)^2} = \frac{15 \text{ kg/s}}{(1.0 \times 10^3 \text{ kg/m}^3) \pi \left(\frac{0.10 \text{ m}}{2} \right)^2}$$

$$v = 1.91 \text{ m/s}$$

b) Find the flow speed in the nozzle.

Use the same formula as above except with the diameter of the nozzle.

$$v = \frac{R}{\rho \pi \left(\frac{D}{2} \right)^2} = \frac{15 \text{ kg/s}}{(1.0 \times 10^3 \text{ kg/m}^3) \pi \left(\frac{0.025 \text{ m}}{2} \right)^2}$$

$$v = 30.6 \text{ m/s}$$

†Problem from Essential University Physics, Wolfson