

43. (a) We use the equation of continuity: $A_1 v_1 = A_2 v_2$. Here A_1 is the area of the pipe at the top and v_1 is the speed of the water there; A_2 is the area of the pipe at the bottom and v_2 is the speed of the water there. Thus $v_2 = (A_1/A_2)v_1 = ((4.0 \text{ cm}^2)/(8.0 \text{ cm}^2)) (5.0 \text{ m/s}) = 2.5 \text{ m/s}$.
- (b) We use the Bernoulli equation: $p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$, where ρ is the density of water, h_1 is its initial altitude, and h_2 is its final altitude. Thus

$$\begin{aligned} p_2 &= p_1 + \frac{1}{2}\rho(v_1^2 - v_2^2) + \rho g(h_1 - h_2) \\ &= 1.5 \times 10^5 \text{ Pa} + \frac{1}{2}(1000 \text{ kg/m}^3) ((5.0 \text{ m/s})^2 - (2.5 \text{ m/s})^2) + (1000 \text{ kg/m}^3)(9.8 \text{ m/s}^2)(10 \text{ m}) \\ &= 2.6 \times 10^5 \text{ Pa} . \end{aligned}$$