October 1, 2012

1. The velocity distribution for the flow of a Newtonian fluid between two wide, parallel plates (See Fig. 1) is given by the equation

$$u = \frac{3V}{2}\left[1 - \left(\frac{y}{h}\right)^2\right]$$

where V is the mean velocity. The fluid has a viscosity of 0.04 lb·s/ft^2. Also, V = 2 ft/s and h = 0.2 in. Determine: (a) the shear stress, τ, acting on the bottom plane (at y = -h) and (b) the resulting shear-force $F = \tau \cdot A$ where A =2 ft^2 is the area of the bottom wall.

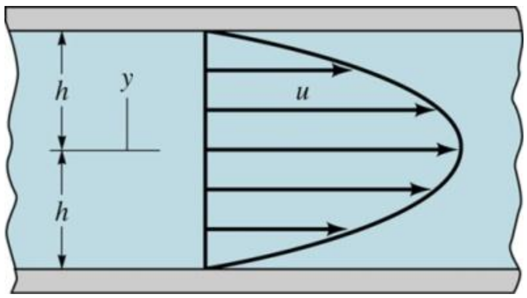

Fig. 1

2. The flow of water (γ = 62.4 lb/ft^3) from a reservoir is controlled by a 5-ft-wide L-shaped gate hinged at Point A, as shown in Fig. 2. If it is desired that the gate open when the water height is 12 ft, determine the mass of the required weight W.

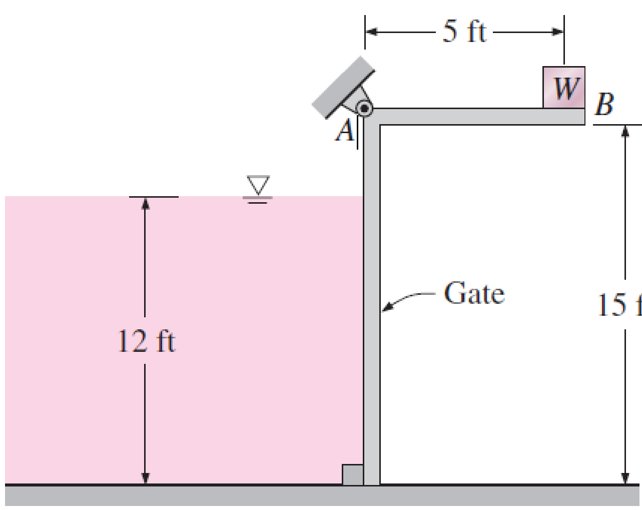

Fig. 2

October 1, 2012

3. In Fig. 3, air (ρ = 1.31 kg/m^3) exits from a nozzle, which has the diameter of 7 cm at the section (1) and 4 cm at the section (2), into atmospheric pressure (p_{atm} = 0 gage). If the manometer fluid has a specific gravity *SG* = 0.8 and the manometer reading is h = 5 cm, with friction neglected, determine: (a) The gage pressure at section (1) by using the manometer reading, (b) Find the relationship between the velocities at section (1) and (2), and (c) Determine the velocity at section (2). (Note: γ_{water} = 9,790 N/m^3)

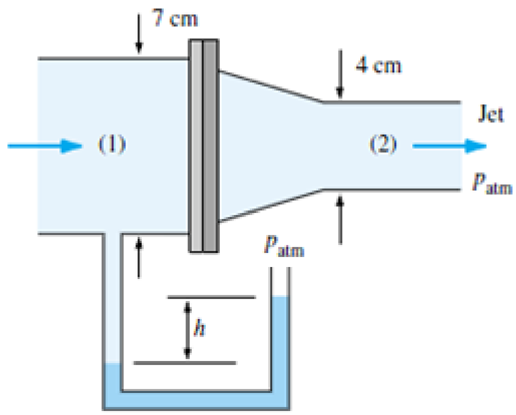

Fig. 3

4. A simple flow model for a two-dimensional converging nozzle shown in Fig. 4 is given as $u = U_0(1 + 2\,x/L)$ along the nozzle center line, where U_0 = 6 m/s and L = 0.1 m. Find (a) the acceleration a_x at $x = L$ and (b) the pressure p at $x = L$ by integrating the Euler equation $\frac{\mathrm{dp}}{\mathrm{dx}} = -\rho a_x$. The fluid is air with ρ = 1.23 kg/m^3 and the pressure at x = 0 is p_0 = 177 Pa (gage).

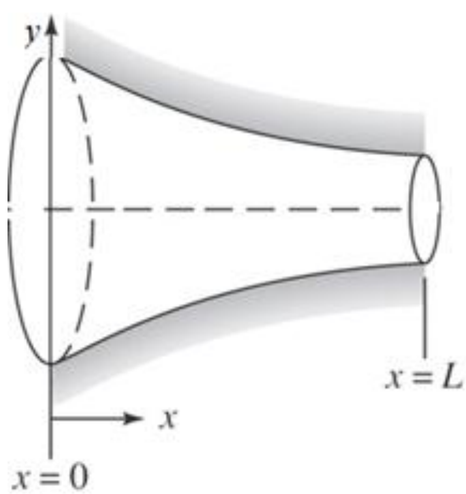

Fig. 4