EXAM #2 November 10, 2008

1. For the pipe-flow-reducing section of Fig.1, D_1 = 8 cm, D_2 = 5 cm, and p_2 = 1 atm. All fluids are at 20°C. If V_1 = 5 m/s and the manometer reading is h = 58 cm, estimate the total horizontal force resisted by the flange bolts. (ρ_{water} = 998 Kg/m^3 and ρ_{macury} = 13,546 Kg/m^3 @ 20°C)

2. Gasoline (SG = 0.68) flows through a pump at 0.12 m^3/s as indicated in Fig. 2. The head loss between sections (1) and (2) is h_L = $0.3V_1^2/2g$. What will the difference in pressures between sections (1) and (2) be if $\dot{W}_p$ = 20 kW is delivered by the pump to the fluid?
(ρ = 999 Kg/m^3 for water; 1 W = 1 N·m/s; g = 9.81 m/s^2)

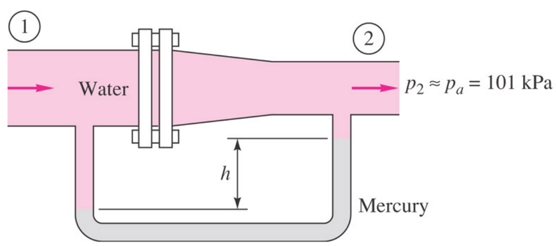

Figure 1

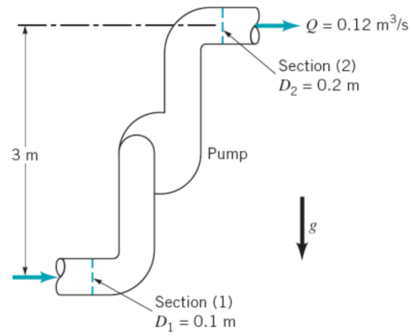

Figure 2

3. Glycerin at 20°C flows in a horizontal 75-mm-diameter pipe shown in Fig.3 with $u_{\max}$ = 1.0 m/s. It is known that the velocity distribution is

$$u(r) = \frac{u_{\max}}{R^2}(R^2 - r^2)$$

Determine:
   a) Wall shear stress τ_w
   b) Pressure difference Δp between sections (1) and (2) using the momentum equation
   c) Head loss h_L between section (1) and (2) using the energy equation

   The distance L between sections (1) and (2) is 10m. (ρ = 1,260 Kg/m^3 and μ = 1.50 N·s/m^2 for glycerin at 20 °C)

4. The water flowrate, Q, in an open rectangular channel can be measured by placing a plate across the channel as shown in Fig. 4. This type of a device is called a *weir*. The height of the water, H, above the weir crest is referred to as the head and can be used to determine the flowrate through the channel. Assume that Q is a function of the head, H, the channel width, b, and the acceleration of gravity, g. Determine a suitable set of dimensionless variables for this problem.

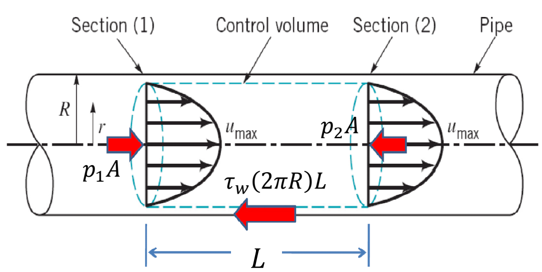

Figure 3

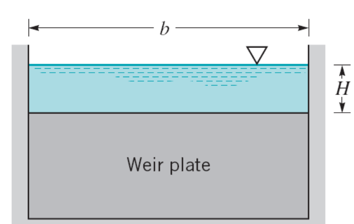

Figure 4