Homework 5 – Answer all five questions

Q1 – Write a haiku or Limerick about fluid mechanics

Q2 - 5.52

Five liters per second of water enter the rotor shown in Video V5.10 and Fig. P5.52 along the axis of rotation. The cross-sectional area of each of the three nozzle exits normal to the relative velocity is 18 mm2. How large is the resisting torque required to hold the rotor stationary if (a) $\theta = 0°$, (b) $\theta = 30°$, and (c) $\theta = 60°$?

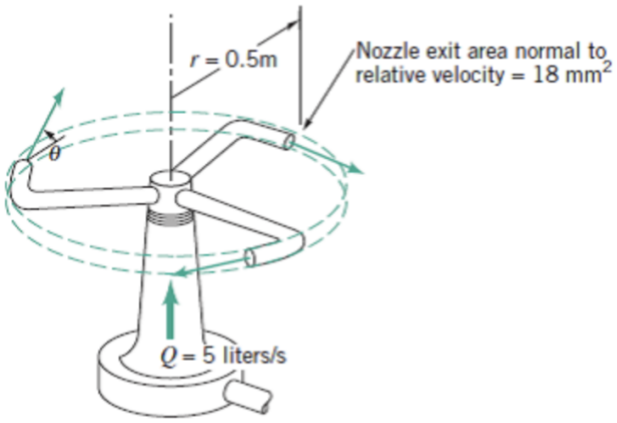

FIGURE P5.52

Q3 - 5.54

Five liters per second of water enter the rotor shown in Video V5.10 and Fig. P5.54 along the axis of rotation. The cross-sectional area of each of the three nozzle exits normal to the relative velocity is 18 mm2. How fast will the rotor spin steadily if the resisting torque is reduced to zero and (a) $\theta = 0°$, (b) $\theta = 30°$, or (c) $\theta = 60°$?

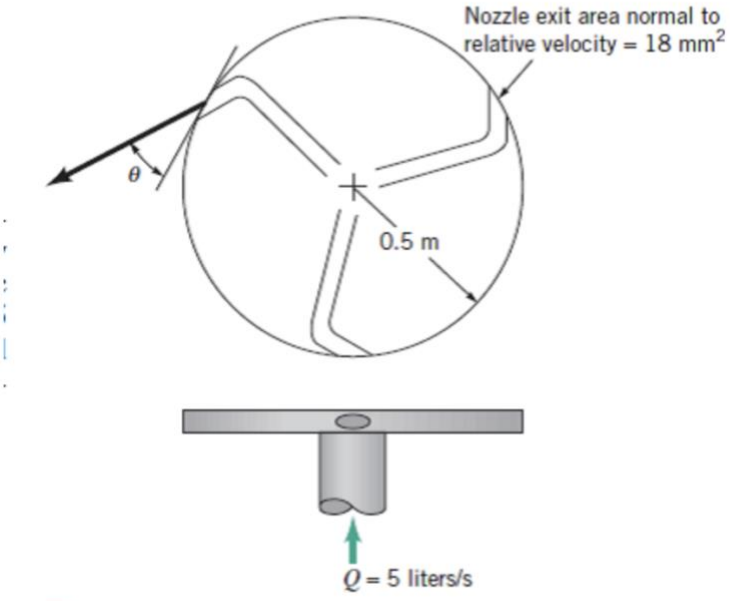

FIGURE P5.54

Q4 - 5.70

Water flows through a valve (see Fig. P5.70) with a weight flowrate,m . g, of 1000 lb/s. The pressure just upstream of the valve is 90 psi, and the pressure drop across the valve is 5 psi. The inside diameters of the valve inlet and exit pipes are 12 and 24 in. If the flow through the valve occurs in a horizontal plane, determine the loss in available energy across the valve.

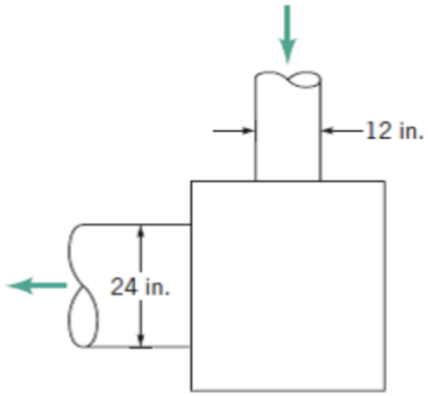

FIGURE P5.70

Q5 - 5.90

Water is to be moved from one large reservoir to another at a higher elevation as indicated in Fig. P5.90. The loss in available energy associated with 2.5 ft3/s being pumped from sections (1) to (2) is $61\ \overline{V}^2/2\ \text{ft}^2/\text{s}^2$, , where V is the average velocity of water in the 8-in. inside-diameter piping involved. Determine the amount of shaft power required.

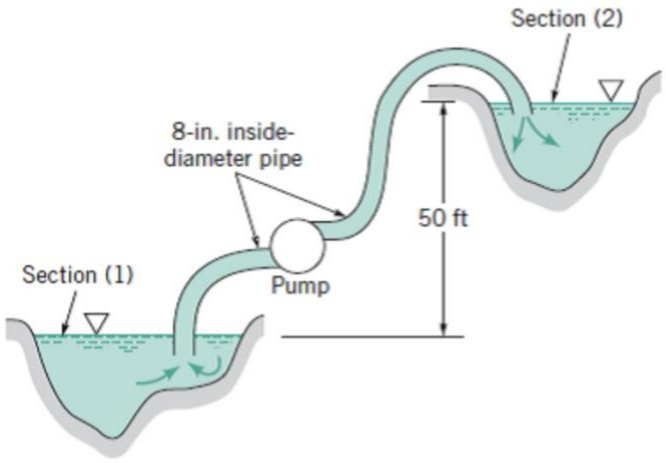

FIGURE P5.90

Q6 - 5.92

(See Fluids in the News article titled "Curtain of air," Section 5.3.3.) The fan shown in Fig. P5.92 produces an air curtain to separate a loading dock from a cold storage room. The air curtain is a jet of air 10 ft wide, 0.5-ft thick moving with speed V = 30 ft/s. The loss associated with this flow is $loss = K_L V^2/2$, where KL=5. How much power must the fan supply to the air to produce this flow?

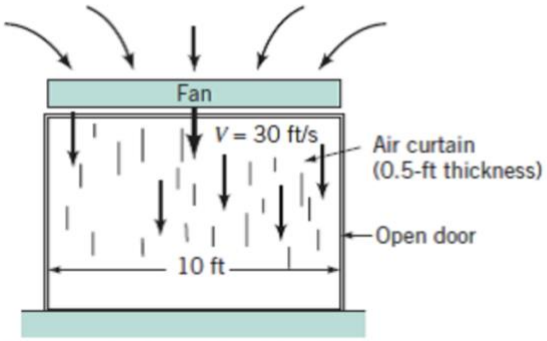

FIGURE P5.92