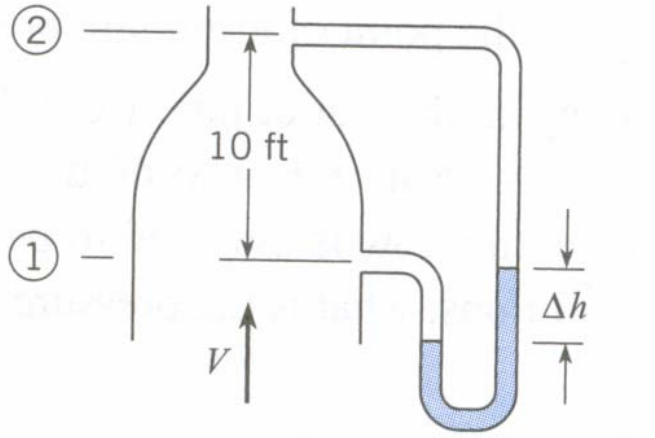
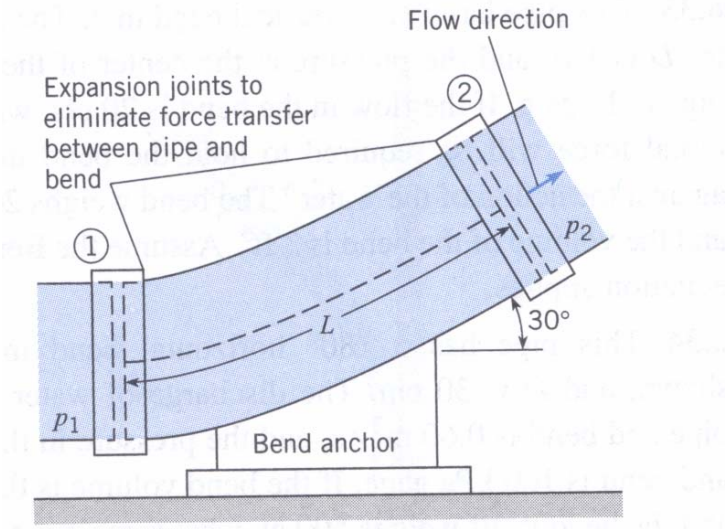
057:20 **TEST # 2** **Fall 2003**

General information: $\gamma_{water} = 62.4\, lbf \,/\, ft^3$, $1hp = 550\ ft\text{-}lbf\,/s$

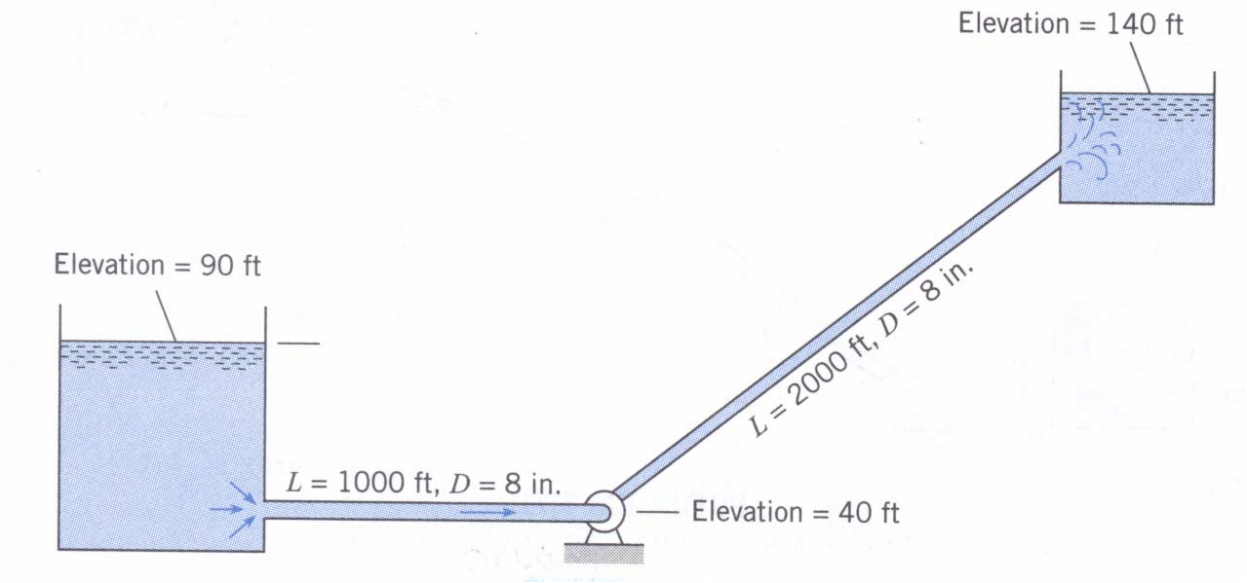
1. Air with a density of $0.0644 lbm/\, ft^3$ is flowing upward in the vertical duct, as shown. The velocity at the inlet (station 1) is $100\ ft/sec$, and the area ratio between station 1 and 2 is $0.5\left(A_2/A_1 = 0.5\right)$. Two pressure taps, $10\, ft$ apart, are connected to a manometer, as shown. The specific weight of the manometer liquid is $120 lbf \,/\, ft^3$. Find the deflection, Δh , of the manometer.



2. This 30° vertical bend in a pipe with a 2-ft diameter carries water at a rate of $31.4 cfs$. If the pressure p_1 is $10 psi$ at the lower end of the bend, where the elevation is $100\, ft$, and p_2 is $8.5 psi$ at the upper end, where the elevation is $103\, ft$, what will be the vertical component of force that must be exerted by the "anchor" on the bend to hold it in position? The bend itself weights $300 lb$, and length L is $4\, ft$.



3. What horsepower must be supplied to the water to pump $3.0cfs$ from the lower to the upper reservoir? Assume that the head loss in the pipes is given by $h_L = 0.015(L/D)\left(V^2/2g\right)$, where L is the length of the pipe in feet and D is the pipe diameter in feet. Sketch the HGL and the EGL.



4. It is known that for flow past cylinders, vortices are shed alternately from one side of the cylinder and from the other. If the frequency of shedding n is a function of the approach velocity V, the diameter d of the cylinder, the mass density ρ, and the viscosity μ, what are the π-groups for this phenomenon?