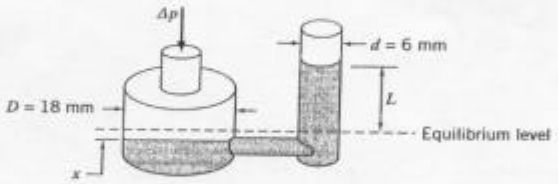
Fluid Mechanics

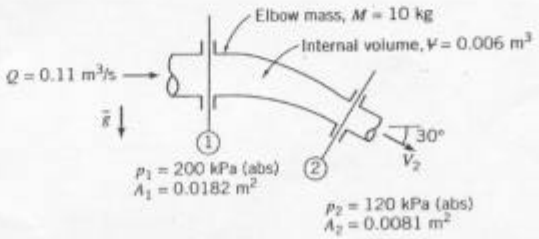
October 2000

1. Give operational definitions of: (5 × 4 points)
   (1) Fluid
   (2) Streamline
   (3) Boundary layer
   (4) Turbulent flow
   (5) Pressure gradient

2. A reservoir manometer has vertical tubes of diameter D = 18 mm and d = 6 mm. The manometer liquid is Meriam red oil (SG = 0.827). Develop an algebraic expression for liquid deflection L in the small tube when gage pressure Δp is applied to the reservoir. Evaluate the liquid deflection when the applied pressure is equivalent to 25 mm of water (gage). (15 points)



3. A 30° reducing elbow is shown. The fluid is water. Evaluate the components of force that must be provided by the adjacent pipes to keep the elbow from moving. (15 points)



Fluid Mechanics Part II

4. (15%) The pressure rise, $\triangle p$, across a pump can be expressed as

$$\triangle p = f(D, \rho, \omega, Q)$$

where D is the impeller diameter, ρ the fluid density, ω the rotational speed, and Q the flowrate. Determine a suitable set of dimensionless parameters.

5. (15%) Water is pumped between two tanks as shown in Fig. 1. The energy line is as indicated. Is the fluid being pumped from A to B or B to A? Explain. Which pipe has the larger diameter: A to the pump or B to the pump? Explain.

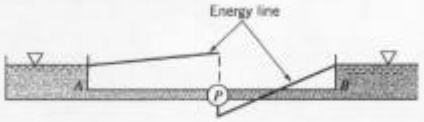


Figure 1

6. (20%) Find the velocity field $\vec{V} = (u, v, w)$ of the steady laminar flow between two horizontal, infinite parallel plates as shown in Fig. 2.

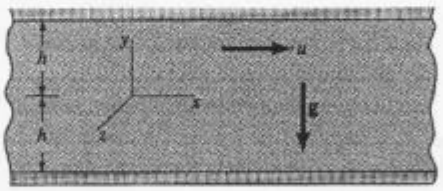


Figure 2