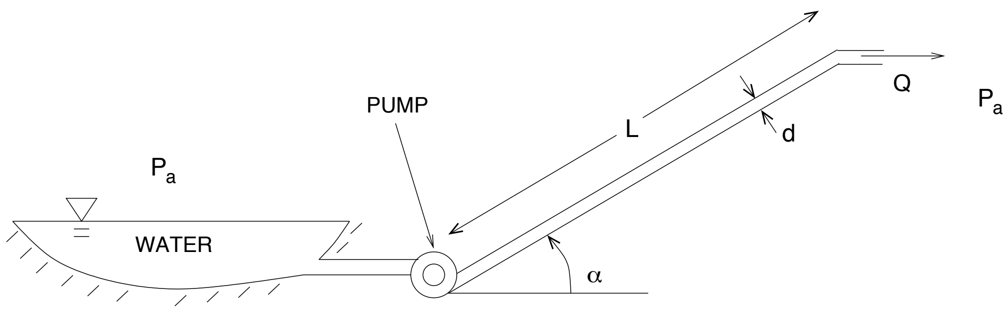

Figure 1: Problem 3.

$Q = 0.1$ m^3/s. For that purpose, an ideal pump of power $\dot{W} = 12$ kW is used. The ambient pressure is P_a, the length of the pipe is $L = 10$ m and the elevation angle is $\alpha = 30°$. Assume turbulent flow (check this assumption after having done all the calculations).

a) Use the energy equation, neglecting kinetic energy at the exit, to show that the diameter of the pipe d can be written as

$$d = \left[\frac{8\rho Q^2 f L}{\pi^2 \left(\frac{\dot{W}}{Q} - \rho g L \sin\alpha \right)} \right]^{1/5}.$$

Also show that the diameter-based Reynolds number can be written as a function of the flow rate Q as $\mathrm{Re}_d = 4\rho Q/\pi d\mu$.

b) Use the two above expressions and the appropriate roughness to calculate the diameter of the pipe by iterating on the Moody chart.

4. A stainless steel pipe of internal diameter $D = 5$ cm carries water with an average velocity $V = 1$ m/s. Compute the head loss and pressure drop per unit of pipe length.

5. An ideal turbine extracts 250 W of power in the configuration shown in the figure. The pipes are made of wrought iron. What is the flow rate Q in m^3/h?. The atmospheric pressure is P_a.

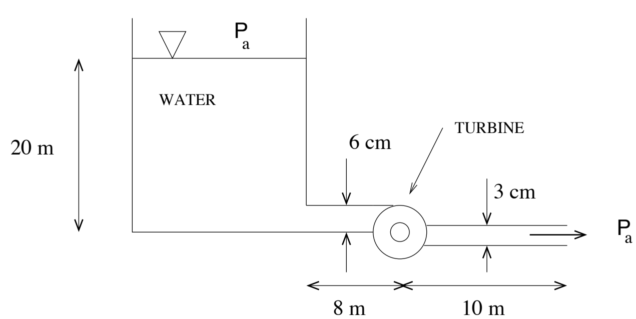

Figure 2: Problem 5.

Ungraded problems From text. 6.40, 6.148.