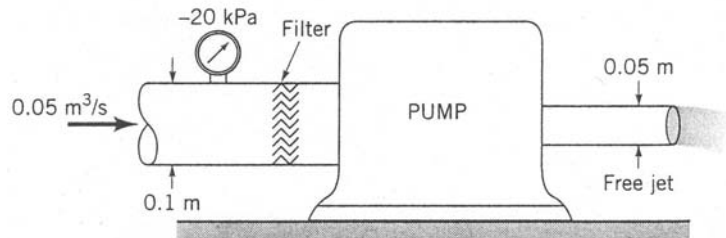


10.303 & 14.301 Fluid Mechanics
Homework Assignment #8 Fall 2006

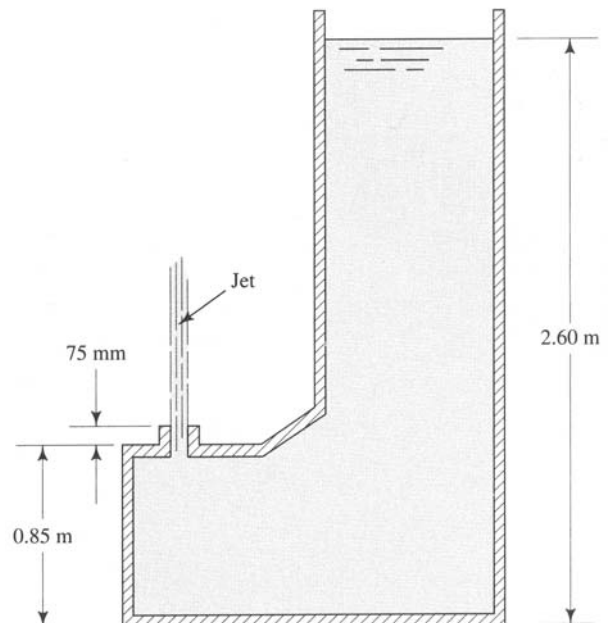
The General Energy Equation

1. The pump shown in the diagram adds 20 kW of power to the flowing water. The only major loss in the system is that which occurs across the filter at the inlet of the pump.

With the data given, determine the head loss for this filter.



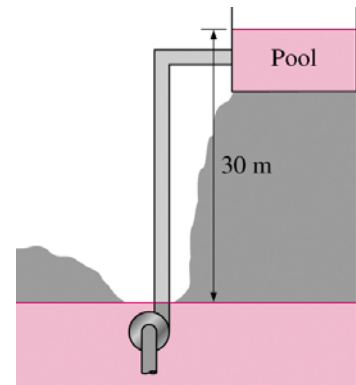
2. Consider the situation shown in the diagram where the nozzle outlet diameter is 0.05 m.
- If the maximum height of the jet is 2.2 m above the bottom of the container, estimate the exit velocity of the jet.
 - If the head loss due to the nozzle is given by $K(v^2/2g)$, with v being the average stream velocity at the exit of the nozzle, what is the resistance coefficient, K , for the nozzle?
 - If the fluid height in the large tank is increased to 3.0 m, what will be the new maximum jet height and the new nozzle exit velocity?



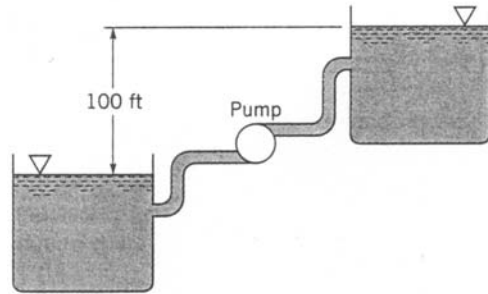
Note: Assume that all the head loss in this system is associated with the fluid acceleration changes that occur at the nozzle. Also assume steady flow in all parts to this problem.

3. Underground water is to be pumped by a 70 % efficient 3 kW submerged pump to a pool whose free surface is 30 m above the underground water level. The diameter of the pipe is 7 cm on the intake side and 5 cm on the discharge side.

Assuming negligible elevation distance between the pump inlet and outlet, determine the maximum flow rate of water and the ΔP across the pump.



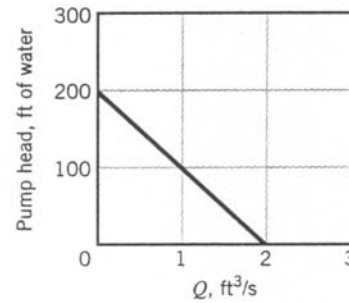
4. A pump transfers water from one large reservoir to another as shown in the diagram. The frictional head loss in the piping is given by $Kv^2/2g$, where v is the average fluid velocity and K is the loss coefficient, which is considered constant.



(a)

The relationship between the total head across the pump, h_A , and the flow rate, Q , is also given in the sketch -- the pump curve.

If $K = 40$ and the pipe diameter is 4 inches everywhere, what is the flow rate through the pump?



(b)

5. Water enters a hydraulic turbine through a 30 cm diameter pipe at a rate of $0.6 \text{ m}^3/\text{s}$ and exits through a 25 cm diameter pipe. The pressure drop in the turbine is measured to be 1.2 m of Hg. For a combined turbine-generator efficiency of 83 %, determine the net electric power output.

