

HW#9 SP 07

#1.

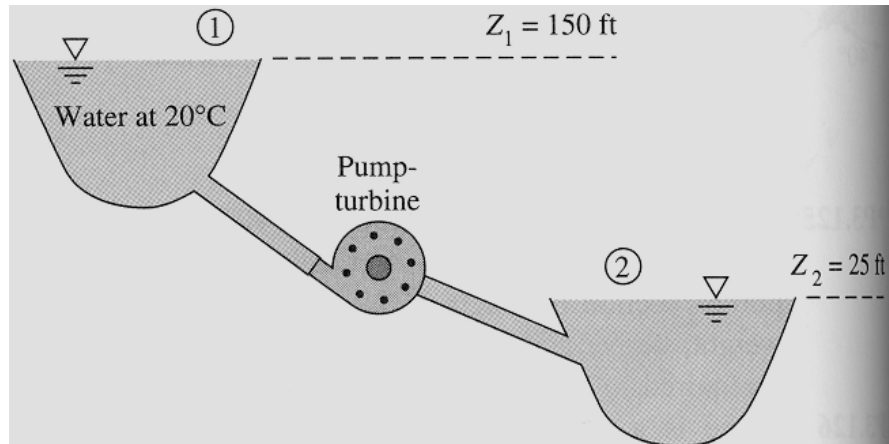
Air at standard conditions enters a compressor at 75 m/s and leaves at an absolute pressure and temperature of 200 kPa and 345 K, respectively and speed $V = 125$ m/s. The flow rate is 1 kg/s. The cooling water circulating around the compressor casing removes 18 kJ/kg of air. Determine the power required by the compressor.

#2.

Air is drawn from the atmosphere into a turbomachine. At the exit, conditions are 500kPa (gage) and 130°C. The exit speed is 100 m/s and the mass flow rate is 0.8 kg/s. Flow is steady and there is no heat transfer. Compute the shaft work interaction with the surrounding.

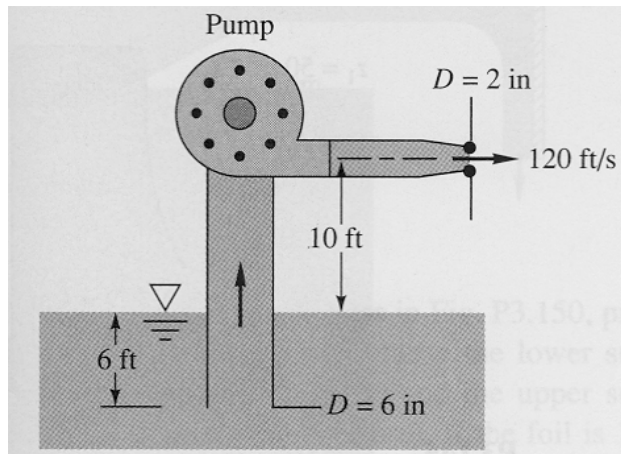
#3.

The *pump-turbine* system in the figure draws water from the upper reservoir in the daytime to produce power for a city. At night, it pumps water from lower to upper reservoirs to restore the situation. For a design flow rate of 15,000 gal/min in either direction, the friction head loss is 17 ft. Estimate the power in kW (a) extracted by the turbine and (b) delivered by the pump.



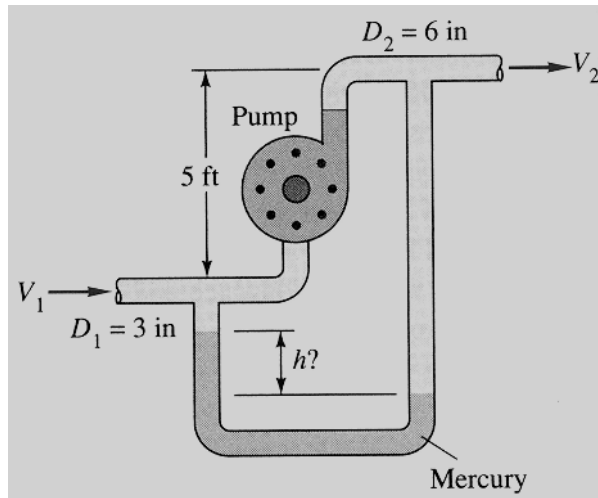
#4.

The fireboat draws seawater ($SG = 1.025$) from a submerged pipe and discharges it through a nozzle, as in the figure. The total head loss is 6.5 ft. If the pump efficiency is 75 percent, what horsepower motor is required to drive it?



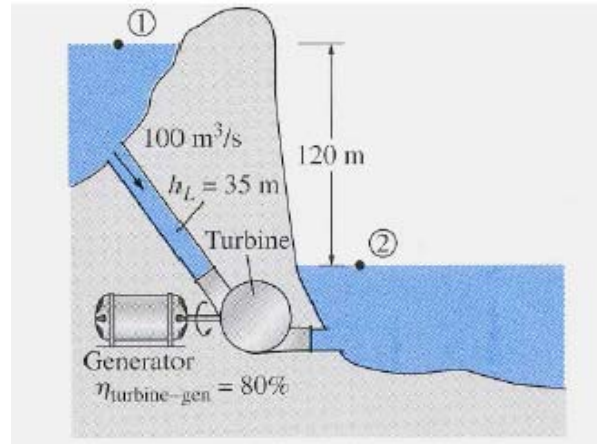
#5.

Kerosene at 20°C flows through the pump in the figure at $2.3 \text{ ft}^3/\text{s}$. Head losses between 1 and 2 are 8 ft, and the pump delivers 8 hp to the flow. What should the mercury manometer reading h ft be?



#6.

In a hydroelectric power plant, $100 \text{ m}^3/\text{s}$ of water flows from an elevation of 120 m to a turbine, where electric power is generated. The total irreversible head loss in the piping system from point 1 to point 2 (excluding the turbine unit) is determined to be 35 m . If the overall efficiency of the turbine generator is 80% , estimate the electric power output.



#7.

A fireboat is to fight fires at coastal areas by drawing seawater with a density of 1030 kg/m^3 through a 20 cm -diameter pipe at a rate of $0.1 \text{ m}^3/\text{s}$ and discharging it through a hose nozzle with an exit diameter of 5 cm . The total irreversible head loss of the system is 3 m , and the position of the nozzle is 4 m above sea level. For a pump efficiency of 70% , determine the required shaft power input into the pump and the water discharge velocity.

