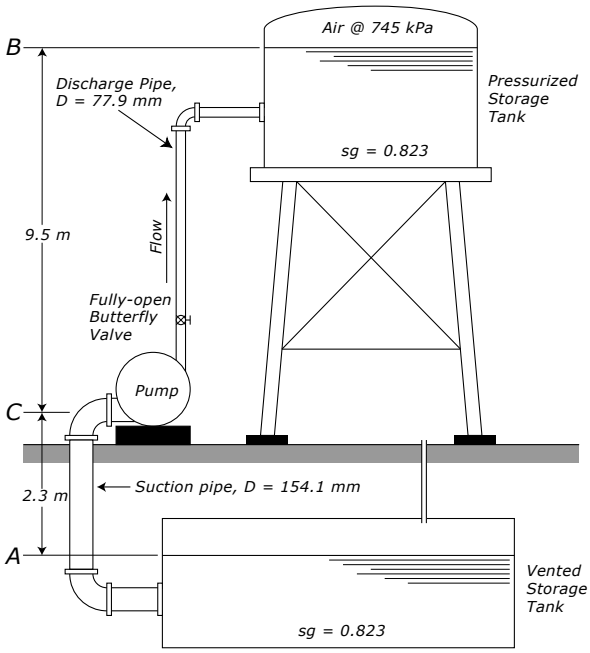
Module 7: Series A Pipeline (CIVL 318)

Example 1:



A pump delivers $13.5\,\mathrm{L/s}$ of kerosene at 25°C from an underground vented storage tank to an elevated storage tank pressurized to $745\,\mathrm{kPa}$.

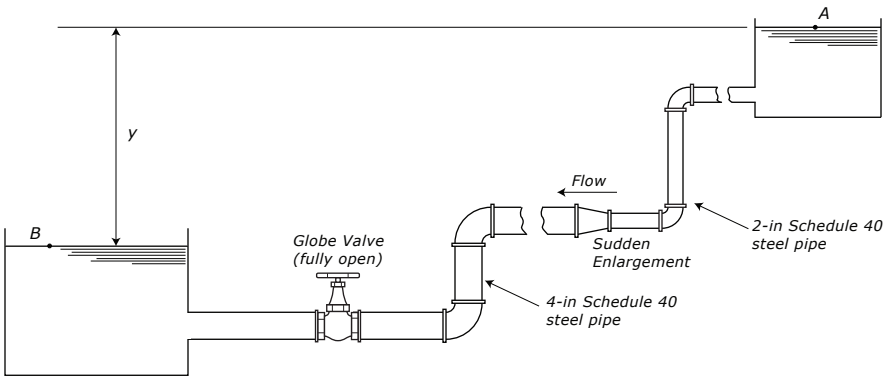
The suction pipe is 6-in Schedule 40 steel pipe and is $5.0\,\mathrm{m}$ long. It has a round-edged entrance with a radius of $r = 15$ mm.

The discharge pipe is 3-in Schedule 40 steel pipe, is $11.0\,\mathrm{m}$ long and includes a fully open butterfly valve with $L_e/D = 45$.

All elbows are "standard" with $L_e/D = 30$.

Determine the power drawn (the power in, P_I) by the pump.

Example 2:

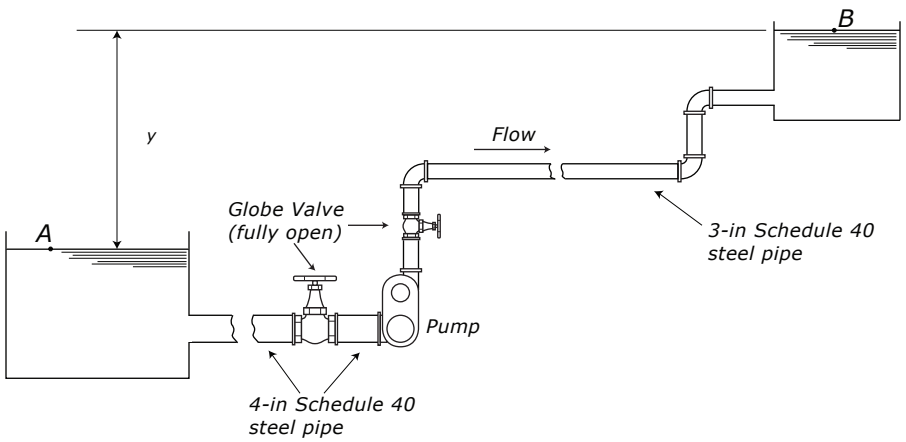


Gasoline at 25℃ flows under gravity from tank A to tank B; both tanks are open to the atmosphere.

The 2-in Schedule 40 steel pipe has a square entrance and is 45.7 m in length. The 4-in Schedule 40 steel pipe contains a fully-open globe valve and is 87.5 m in length. There is a sudden enlargement between the two pipes, as shown. Both pipes are new commercial steel. All elbows are standard 90°.

Determine the elevation difference, y, between the surfaces of tanks A and B that is required to maintain a flow of 425 L/min.

Example 3:



Water at 25 ℃ is pumped from tank A to tank B. Both tanks are open to the atmosphere.

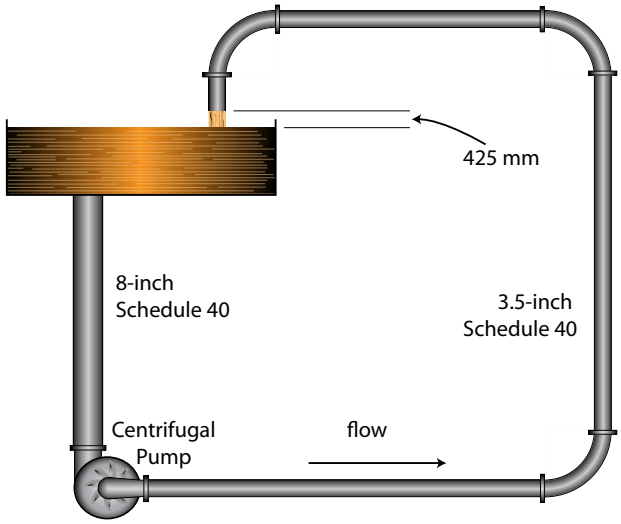
The suction pipe is 4-in Schedule 40 steel pipe, has a well-rounded ($r/D > 0.15$) entrance, contains a fully open globe valve, and is 17.0 m long.

The discharge pipe is 3-in Schedule 40 steel pipe, contains a fully open globe valve and three standard 90° elbows; it is 163.3 m long.

The elevation difference between A and B is $y = 12.75$ m and the volume flow rate is $Q = 900$ L/min.

If the pump is 78% efficient, determine the electrical power it uses.

Example 4:



Heavy machine oil (sg=0.89, $\eta = 3.80 \times 10^{-2}$ Pa·s) is circulated through a system repeatedly to test its stability.

The 8-inch Schedule steel pipe on the suction side of the pump has a square entrance and a length of 6.25 m and the 3.5-inch Schedule steel pipe on the discharge side of the pump has a length of 18.0 m.

(Note that the 3.5-inch discharges into the atmosphere **above** the tank so there is no exit loss in this question!)

All elbows are long radius. The flow rate through the system is 13.5 L/s.

Determine the head added by the pump.