

**33.42**  $175^{\circ}F$  water is pumped from a tank vented to the atmosphere. The top of the water level is at least  $5ft$  above the centerline of the pump. The friction losses in the suction piping are  $3ft$  per hundred feet of pipe. The pump manufacture's data state that the NPSHR for the pump selected is  $10ft$ . What is the maximum length of suction piping that may be used without allowing cavitation?

- A.  $17ft$
- B.  $450ft$
- C.  $970ft$
- D.  $1100ft$

Increasing the length of piping will increase the friction losses in the suction piping until the **Net Positive Suction Head Available** is reduced to the minimum allowable value, which is the net positive suction head *required*. Setting the two equal is the worst case and will establish the *maximum* length for the suction piping.

$$NPSH_A \geq NPSH_R$$

$$NPSH_A = NPSH_R = 10ft$$

Write the equation for  $NPSH_A$  where all terms can be specified except  $h_f$  which can only be expressed as a function of the length of the suction piping,  $L$ .  $3ft$  per  $100ft$  is equivalent to  $0.03ft/ft$ . The vapor pressure is found using the **Properties of Saturated Water and Steam** table and looking up the saturation pressure corresponding to  $175^{\circ}F$ , then converting from  $psi$  to  $ft$  using the rule of thumb conversion factor for water,  $2.31 \frac{ft}{psi}$ . Substitute all known values and solve for  $L$ .

$$NPSH_A = h_p + h_z - h_{vpa} - h_f$$

$$10ft = (14.7psi) \left( 2.31 \frac{ft}{psi} \right) + 5ft - (6.73psi) \left( 2.31 \frac{ft}{psi} \right) - \left( 0.03 \frac{ft}{ft} \right) L$$

$$13.41ft = (0.03) L$$

$$L = 447ft$$

**Answer B**