46.46 A condenser water pump is located $5ft$ below the top of the waterline of a cooling tower basin. The leaving water temperature is $75°F$. The friction loss on the suction side of the pump is $9ft$ of head. What is the net positive suction head available?

A. $4ft$

B. $9ft$

C. $29ft$

D. $37ft$

Refer to the first formula in the Reference Handbook for Net Positive Suction Head Available. Calculate the NPSHA by taking the sum of the atmospheric pressure, h_p, and the height of the fluid column on the suction side of the pump, h_z, minus the vapor pressor, h_{vpa}, and the losses on the suction side, h_f. The vapor pressure is the saturation pressure at the temperature of the water and can be found using the Properties of Saturated Water and Steam table by temperature.

$$h_{vpa} = P_{sat@75°F} = 0.43psi\left(2.31\frac{ft}{psi}\right) \approx 1ft$$

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

$$NPSH_A = 34ft + 5ft - 1ft - 9ft = 29ft$$

Answer C

46.47 The flow of a centrifugal pump developing $150ft$ of head is reduced from $500gpm$ to $300gpm$. After the speed reduction, what is the head added by the pump?

A. $32ft$

B. $54ft$

C. $90ft$

D. $250ft$

Refer to the Pump Affinity Laws. For a change in speed, the change in volume flow rate is proportional to the change in speed. Calculate the ratio of the new speed to the old speed.

$$\frac{N_2}{N_1} = \frac{Q_2}{Q_1} = \frac{300gpm}{500gpm} = 0.6$$

The change in head is a function of the *square* of the change in speed. Calculate the new head after the speed change.

$$\frac{h_2}{h_1} = \left(\frac{N_2}{N_1}\right)^2$$

$$h_2 = h_1\left(\frac{N_2}{N_1}\right)^2 = (150ft)\,(0.6)^2 = 54ft$$

Answer B

46.48 A manometer uses mercury to measure the pressure inside a gas storage tank. One end of the manometer is open to the atmosphere. The height of the column of mercury is $18in$. What is the pressure inside the tank?

A. $9psia$

B. $18psia$

C. $24psia$

D. $37psia$

Refer to the Commonly Used Equivalents, taking note of the relationship between inches of mercury and psi.

$$1in\,of\,mercury = 0.491psi$$

Since the manometer is open to the atmosphere on one side, the height of the column of mercury measures the gauge pressure only. The absolute pressure must account for atmospheric pressure which is exerted on the open manometer in addition to the mercury. Determine the pressure of the column of mercury and add $14.7psi$ for the atmosphere.