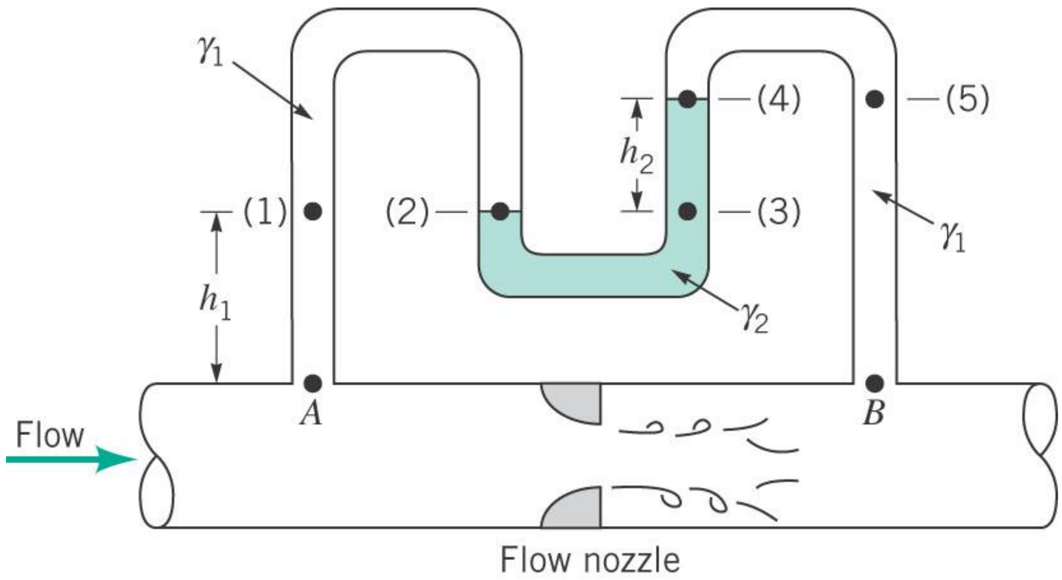
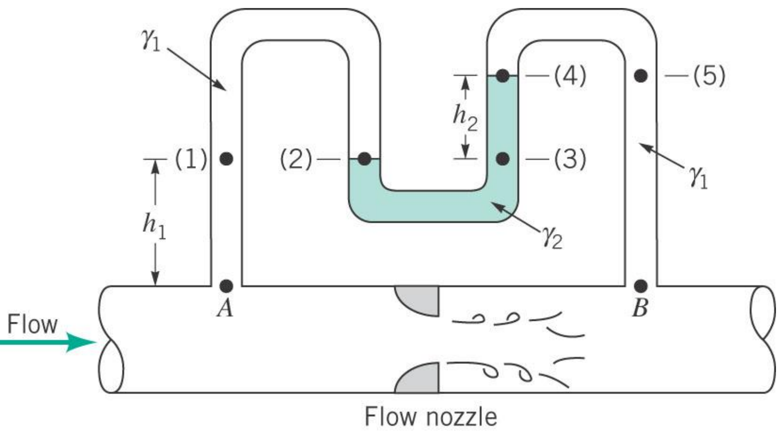
2-3:

(a) Determine an equation for $p_A - p_B$ in terms of the specific weight of the flowing fluid, γ_1, the specific weight of the gage fluid, γ_2, and the various heights indicated.

(b) For $\gamma_1 = 9.80\ \text{kN/m}^3$, $\gamma_2 = 15.6\ \text{kN/m}^3$, $h_1 = 1.0$ m, and $h_2 = 0.5$ m, what is the value of the pressure drop, $p_A - p_B$?





a)

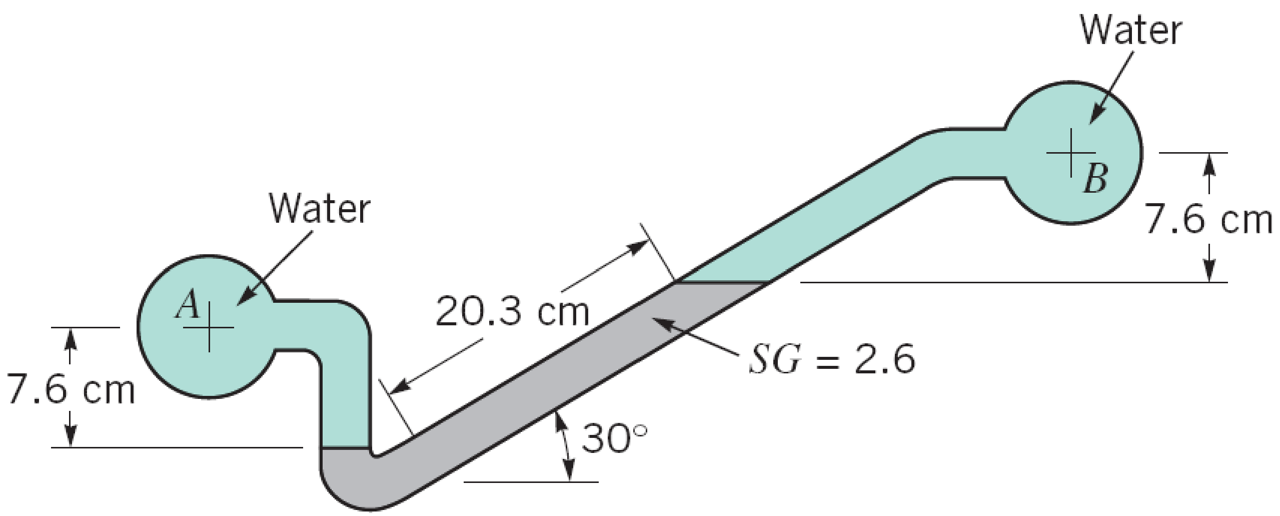
$$p_A - \gamma_1 h_1 - \gamma_2 h_2 + \gamma_1 (h_1 + h_2) = p_B$$

$$p_A - p_B = h_2(\gamma_2 - \gamma_1)$$

b)

$$\begin{aligned} p_A - p_B &= (0.5 \text{ m})(15.6 \text{ kN/m}^3 - 9.80 \text{ kN/m}^3) \\ &= 2.90 \text{ kPa} \end{aligned}$$

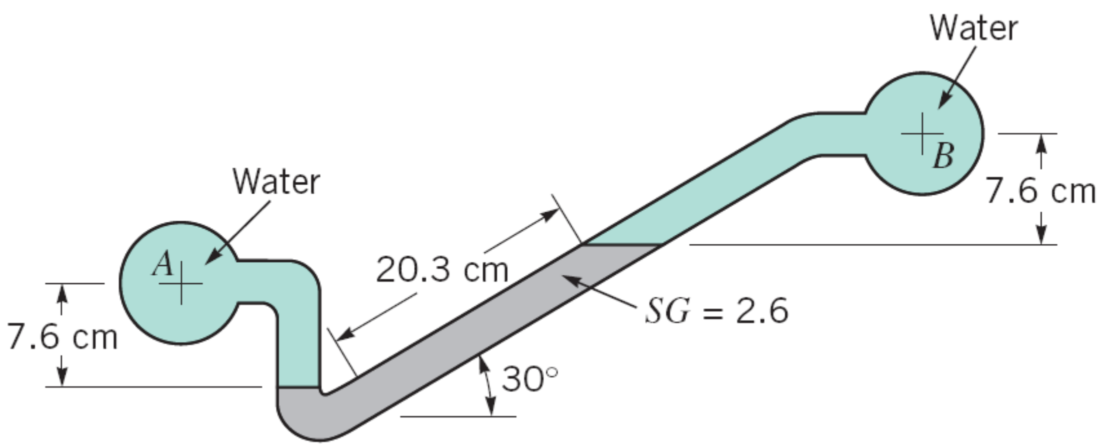
2-26: For the inclined-tube manometer of the figure, the pressure in pipe *A* is 4.1 kPa. The fluid in both pipes *A* and *B* is water, and the gage fluid in the manometer has a specific gravity of 2.6. What is the pressure in pipe *B* corresponding to the differential reading shown?



$$SG = \frac{\gamma}{\gamma_{H_2O}} = \frac{\gamma}{\rho \times g}$$

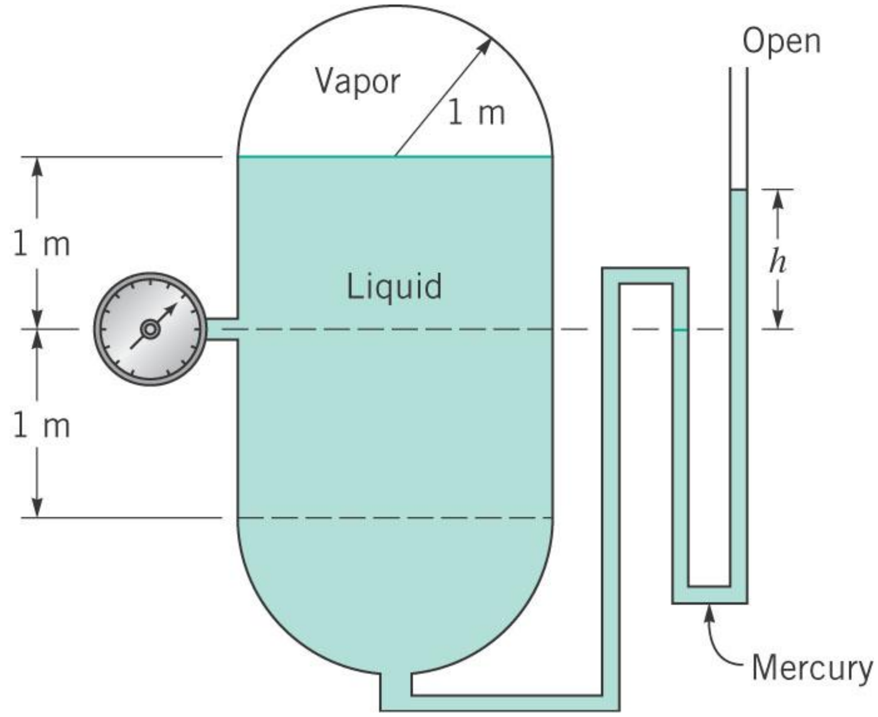
$$P_A + \gamma_{H_2O} \times \left(\frac{7.6}{100} m\right) - \gamma_{gage\ fluid} \times \left(\frac{20.3}{100} m\right) \times \sin 30 - \gamma_{H_2O} \times \left(\frac{7.6}{100} m\right) = P_B$$

$$P_B = (4.1 \times 10^3\ Pa) - (2.6) \times (999.6\ kg/m^3) \times (9.81\ m/s^2) \times \left(\frac{20.3}{100} m\right) \times (0.5) = 1.512\ kPa$$



2.32: The cylindrical tank with hemispherical ends shown in figure contains a volatile liquid and its vapor. The liquid density is 800 kg/m^3, and its vapor density is negligible. The pressure in the vapor is 120 kPa (abs), and the atmospheric pressure is 101 kPa (abs). Determine

a) the gage pressure reading on the pressure gage $\gamma_{Hg} = 133 \times 10^3\ N/m^3$
b) the height, *h*, of the mercury manometer.



a) $\gamma_L = \rho \times g = (800\, kg/m^3) \times (9.81\, m/s^2) = 7850\, N/m^3$

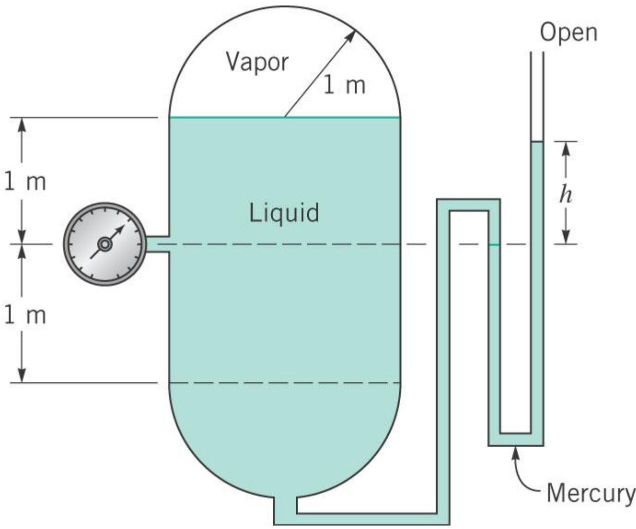
$P_{vapor\ (gage)} = 120\ kPa - 101\ kPa = 19\ kPa$

$P_{gage} = P_{vapor} + \gamma_L \times (1m) = (19 \times 10^3\ N/m^2) + (7850\, N/m^3) \times (1\ m) = 26.9\ kPa$

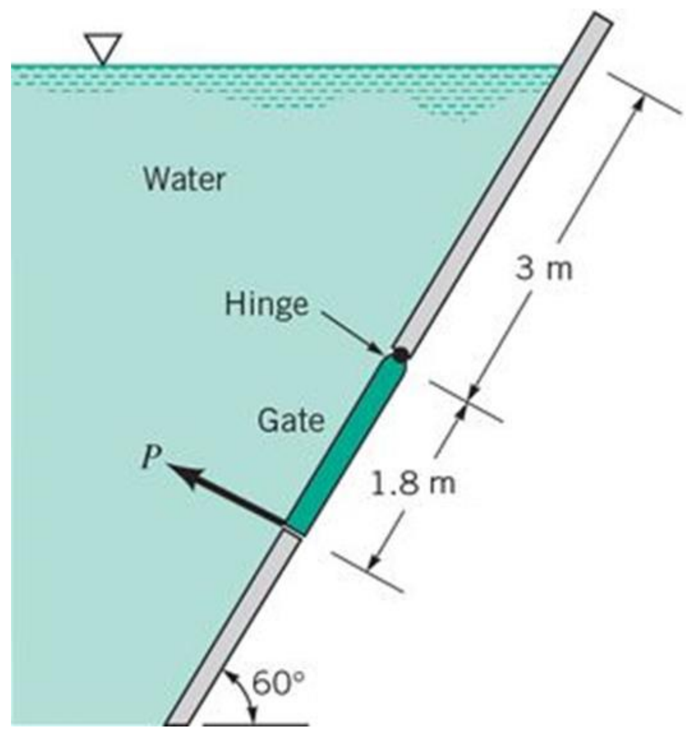
b) $P_{vapor\ (gage)} + \gamma_L \times (1\ m) - \gamma_{Hg} \times (h) = 0$

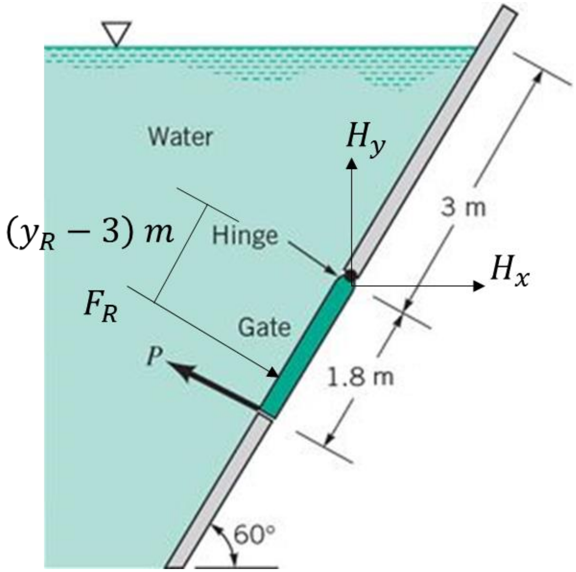
$19 \times 10^3\ N/m^2 + (7850\, N/m^3) \times (1\ m) - (133 \times 10^3\ N/m^3) \times (h) = 0$

$h = 0.202\ m$



2-38: A rectangular gate having a width of 1.2 m is located in the sloping side of a tank as shown in the figure. The gate is hinged along its top edge and is held in position by the force *P.* Friction at the hinge and the weight of the gate can be neglected. Determine the required value of *P.*





$$F_R = \gamma \times h_C \times A$$

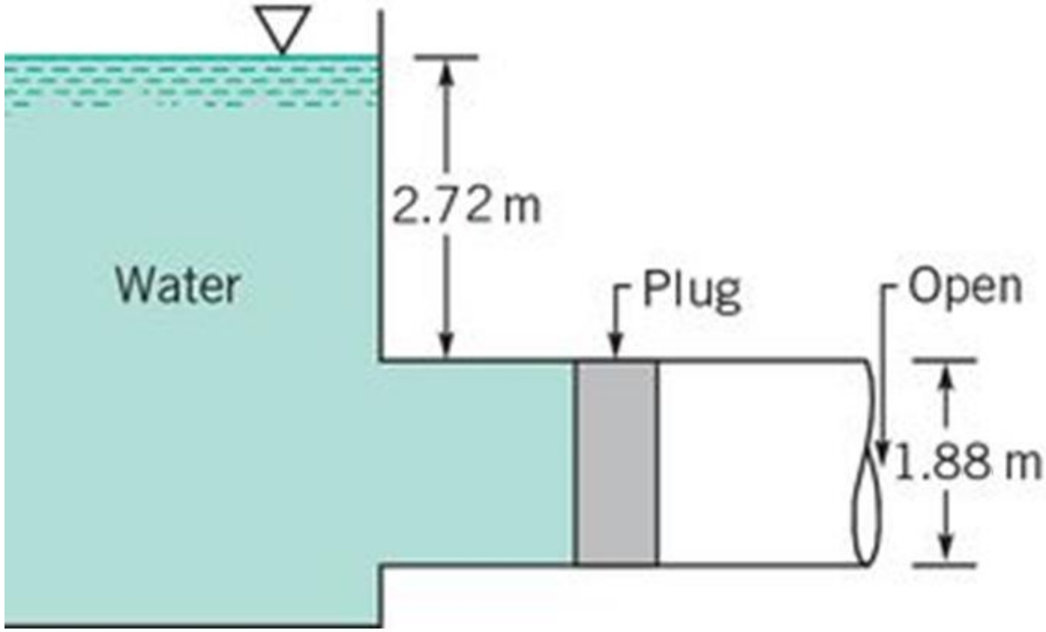
$$= (999.6\, kg/m^3) \times (9.81\, m/s^2) \times (3.9\ m) \times \sin 60 \times (1.8\ m \times 1.2\ m)$$

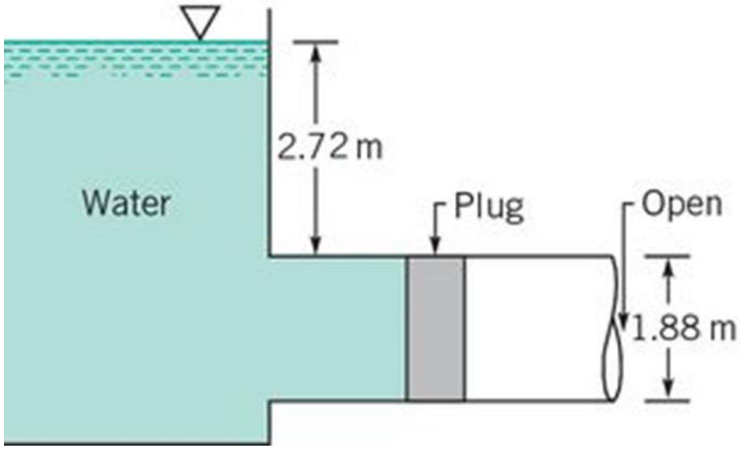
$$= 18343.39\ N$$

$$y_R = \frac{I_{xC}}{y_C \times A} + y_C = \frac{{}^{1}/_{12} \times (1.2\ m) \times (1.8\ m)^3}{(3.9\ m) \times (1.8\ m \times 1.2\ m)} + 3.9\ m = 3.97\ m$$

$$\Sigma M_H = 0 \qquad F_R \times (y_R - 3) = P \times (1.8\ m) \qquad P = \frac{(18343.39\ N) \times (3.97 - 3)\ m}{1.8\ m} = 9885\ N$$

2-40: A large, open tank contains water and is connected to a 1.88 m diameter conduit as shown in the figure. A circular plug is used to seal the conduit. Determine the magnitude, direction, and location of the force of the water on the plug.





$$F_R = \gamma \times h_C \times A$$

$$= (999.6\,kg/m^3) \times (9.81\,m/s^2) \times (3.66\,m) \times (\pi/_4) \times (1.88\,m)^2$$

$$= 94399.22\,N$$

$$y_R = \frac{I_{xC}}{y_C \times A} + y_C$$

$$I_{xC} = \pi/_4 \times (0.94\,m)^4 = 0.55\,m^4$$

$$y_R = \frac{\pi/_4 \times (0.94\,m)^4}{(3.66\,m) \times \pi \times (0.94\,m)^2} + 3.66\,m = 3.72\,m$$

The force is perpendicular to plug.