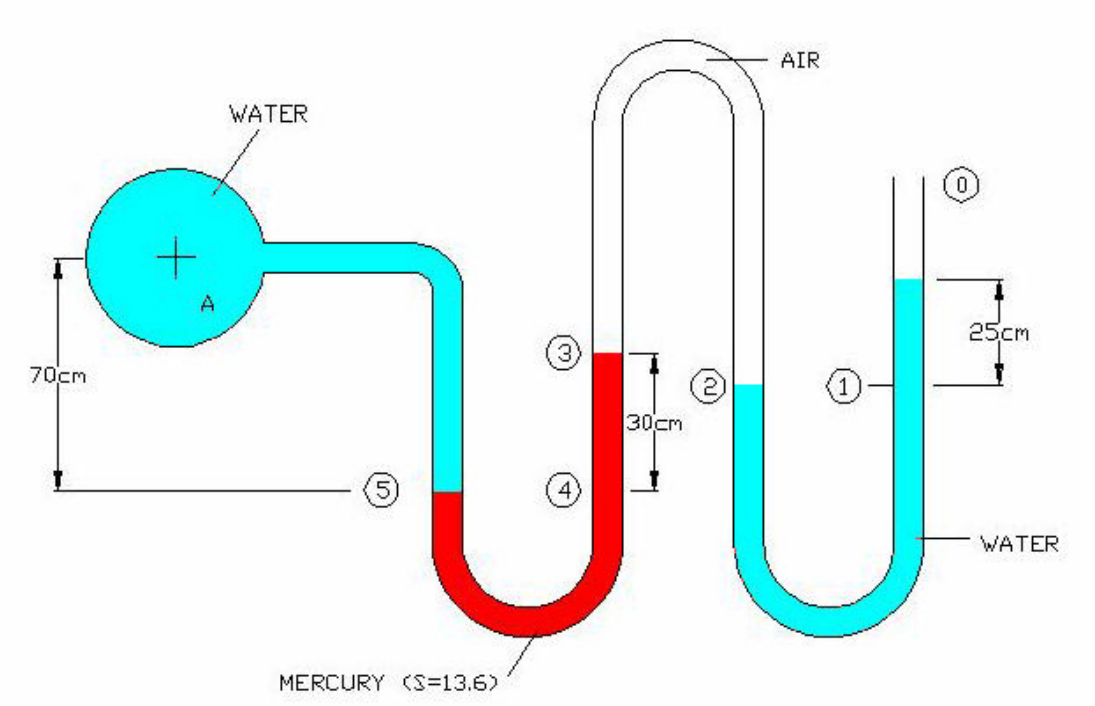
HYDROSTATICS

EXAMPLE PROBLEM: Manometry

Find the pressure at the center of the pipe A. Assume a temperature T = 20^0 C.



SOLUTION

The solution process in this kind of problems is to start from the open end of the manometer (subscript 0) where the pressure is usually known (in this case 1 atm-abs. or 0 atm-gage) and work our way through the manometer.

$p_1 = p_0 + g_{H_2O}(0.25)$

$p_2 = p_1$ (same level)

$p_3 \cong p_2$ even though points 2 and 3 are not at the same level. This is so because $g_{AIR} \prec\prec g_{LIQUID}$ so any aerostatic pressure created due to a column of air (actually any gas) is negligible compared to the hydrostatic pressure created by a column of any liquid.

$p_4 = p_3 + g_{Hg}(0.3)$

$p_5 = p_4$ (same level)

$p_A = p_5 - g_{H_2O}(0.7)$

Adding all the equations by parts we get:

$$p_A = g_{H_2O}(0.25) + g_{Hg}(0.3) - g_{H_2O}(0.7)$$

Substituting $g_{H_2O} = 9{,}790 N/m^3$ for T = 20^0 C, and

$$g_{Hg} = g_{H_2O} S_{Hg} = 9{,}810(13.6) = 133{,}416\ N/m^3$$

we get the pressure at the center of the pipe

$$p_A = 35.6\ kPa\,.$$