SOLUTION

ME 323: Mechanics of Materials **Homework H24**

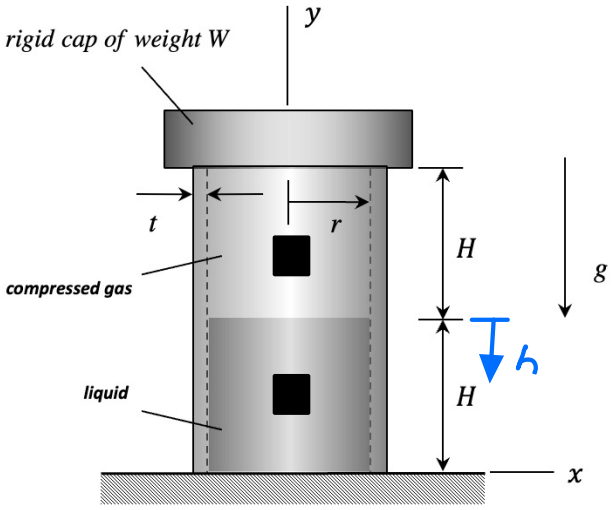
Summer 2025 **Assigned/due: July 21/July 24**

A closed tank holds a liquid (with mass density of ρ) and a compressed gas having a pressure of p, as shown in the figure. The closed tank also supports a rigid cap that weighs W, where W is equal to twice the weight of the liquid. The weight of the gas and the weight of the tank are to be considered to be negligible.

a) Determine the axial stress in the walls of the tank.

b) Determine the hoop stress in the walls of the tank at $y = H/2$. Draw the stress element at this position on the tank.

c) Determine the hoop stress in the walls of the tank at $y = 3H/2$. Draw the stress element at this position on the tank.



a) $\sigma_a = \frac{pr}{2t} - \frac{W}{\pi(r+t)^2 - \pi r^2}$ ← $2\pi rt$ (thin walls)

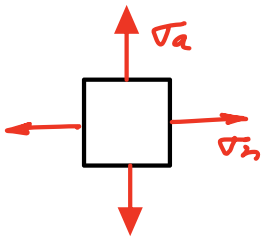
$= \frac{pr}{2t} - \frac{W}{2\pi rt}$

(b) For $0 < y < H$:

$\sigma_h = \frac{(p + \rho g h) r}{t}$

For $h = H/2$:

$\sigma_h = \left(\frac{p + \frac{1}{2}\rho g H}{t}\right) r$



(c) For $H < y < 2H$:

$\sigma_h = \frac{pr}{t}$