PROBLEM 1.45

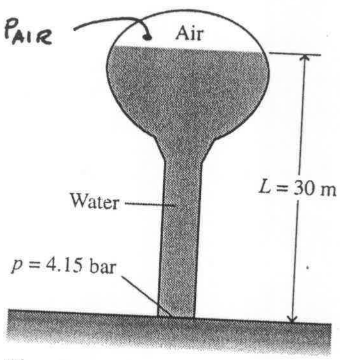

Fig. P1.45

Ignoring the vertical variation in pressure of the air trapped above water level,

$$p = p_{AIR} + \rho g L$$

pressure at the base

$$\Rightarrow \quad p_{AIR} = p - \rho g L$$

$$= 4.15\,\text{bar} - \left(10^3 \frac{\text{kg}}{\text{m}^3}\right)\left(9.81 \frac{\text{m}}{\text{s}^2}\right)(30\,\text{m}) \left|\frac{1\,\text{N}}{1\,\text{kg}\cdot\text{m/s}^2}\right| \left|\frac{1\,\text{bar}}{10^5\,\frac{\text{N}}{\text{m}^2}}\right|$$

$$= 4.15\,\text{bar} - 2.94\,\text{bar} = 1.21\,\text{bar} \quad \longleftarrow$$

PROBLEM 1.46

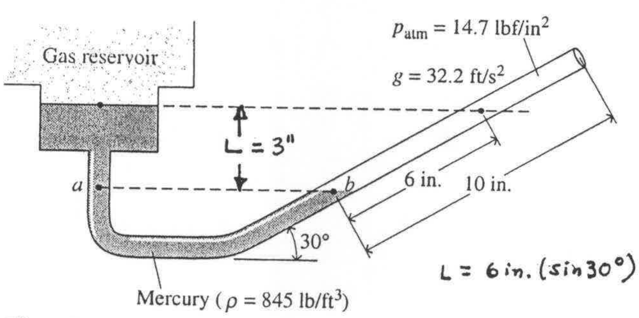

Fig. P1.46

(a) $p_a = p_b$, where $p_b = 14.7 \frac{\text{lbf}}{\text{in}^2}$

Also,

$$p_a = p_{gas} + \rho g L$$

So,

$$p_{gas} = 14.7 \frac{\text{lbf}}{\text{in}^2} - \rho g L$$

That is,

$$p_{gas} = 14.7 \frac{\text{lbf}}{\text{in}^2} - \left(845 \frac{\text{lb}}{\text{ft}^3}\right)\left(32.2 \frac{\text{ft}}{\text{s}^2}\right)\left(\frac{3}{12}\,\text{ft}\right) \left|\frac{1\,\text{ft}^2}{144\,\text{in}^2}\right| \left|\frac{1\,\text{lbf}}{\underbrace{32.2\,\text{lb}\cdot\text{ft/s}^2}_{\text{rounded}}}\right|$$

$$= 14.7 \frac{\text{lbf}}{\text{in}^2} - 1.47 \frac{\text{lbf}}{\text{in}^2} = 13.23 \frac{\text{lbf}}{\text{in}^2} \quad \text{(absolute)} \quad \longleftarrow$$

(b) Since the gas pressure is less than the atmospheric pressure, we have $p_{gas} = 1.47 \frac{\text{lbf}}{\text{in}^2}$ (vacuum) $\longleftarrow$

(c) Because the liquid level change is small for small pressure variations about atmospheric pressure, a U-tube manometer may be difficult to read accurately. The inclined manometer has greater sensitivity and is easier to read accurately. See Introduction to Fluid Mechanics, 5th Edition, Sec. 3-3, by R.W. Fox and A.T. McDonald, J. Wiley & Sons, Inc.